INDEXED

# Marine Engineering

SEPTEMBER, 1905

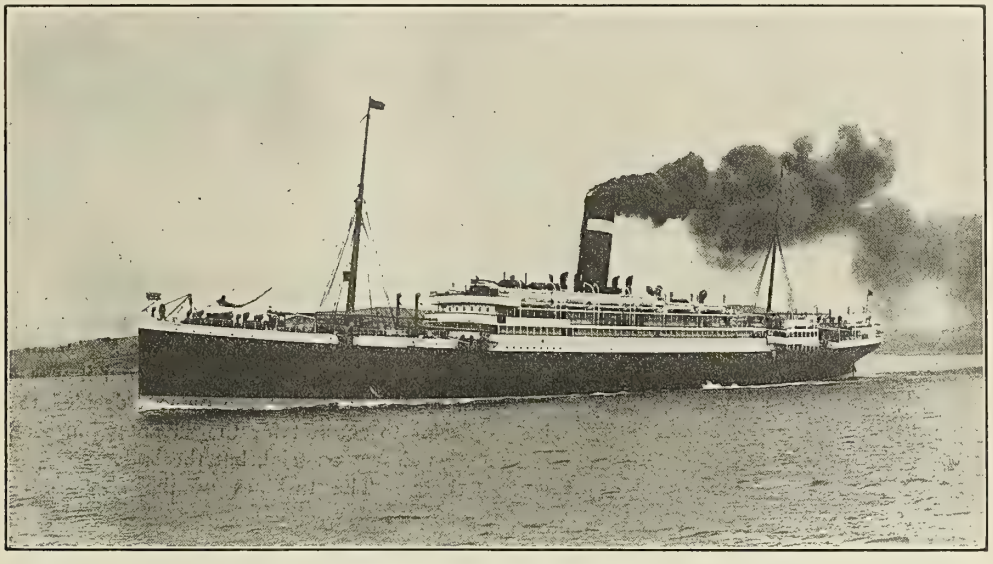
## THE ALLAN LINE TURBINE STEAMERS VICTORIAN AND VIRGINIAN.

BY BENJAMIN TAYLOR.

The Allan liner *Victorian*, the first turbine steamer for the regular Atlantic service, was built by Messrs. Workman, Clark and Company, of Belfast. Messrs. J. & A. Allan, of Glasgow, were thus the first to venture into the comparatively unknown. So confident were they of the fitness of the turbine for the cross-Atlantic trade that they at the same time ordered a sister ship, the *Virginian*, both of which are now in service between Liverpool and Montreal.

The *Victorian* is a triple-screw turbine steamer of 10,630 tons gross. She is 540 feet in length, 60 feet in breadth, 42 feet 6 inches in depth, and has accommodation of the best class for 1,300 passengers. She is divided into eleven compartments, and these, together with the sub-divisions of the double bottom, give her twenty distinct watertight spaces. She has been constructed to the highest class of the British Corporation registry, and the strength of the hull has been specially augmented beyond the requirements of that society to meet the heavy swell of the North Atlantic. First-class accommodation is provided in houses situated on the bridge and promenade decks, and the distance between decks has been made higher than usual in order to allow of state rooms to accommodate two and three persons, and also for a number of suites. The dining saloons for the first-class are placed one at the fore end of the bridge, with seating accommodation for 200 persons, and another at the after end of the bridge, with similar accommodation. On the main deck is the second-class saloon. The first-class music room, library, and writing rooms are at the fore end of the upper bridge, immediately above the forward dining saloon. The smoke room is a large oak-paneled apartment at the after end of the promenade deck. Second-class passengers are accommodated in four-berth rooms on the upper and main decks amidships. The third-class accommodation is arranged in the upper and lower 'tween decks, in four-, five-, and six-berth cabins. Dining saloons, sitting room, music room and smoke rooms have also been provided for the third-class passengers. Special features are ample space, perfect ventilation, and liberal use of the latest ideas of comfort.

The *Victorian* has space available for about 8,000 tons of cargo, and the facilities for its rapid handling and discharge are of the most efficient kind. Special attention has been given to the arrangement of the cargo holds. The ordinary round pillar supports for the decks have been discarded in favor of special girders and struts, which leave the holds freer for the handling of cargo Insulated chambers for the carriage of fruit and dairy produce are provided, in conjunction with refrigerating plant on the cold-air circulation system.

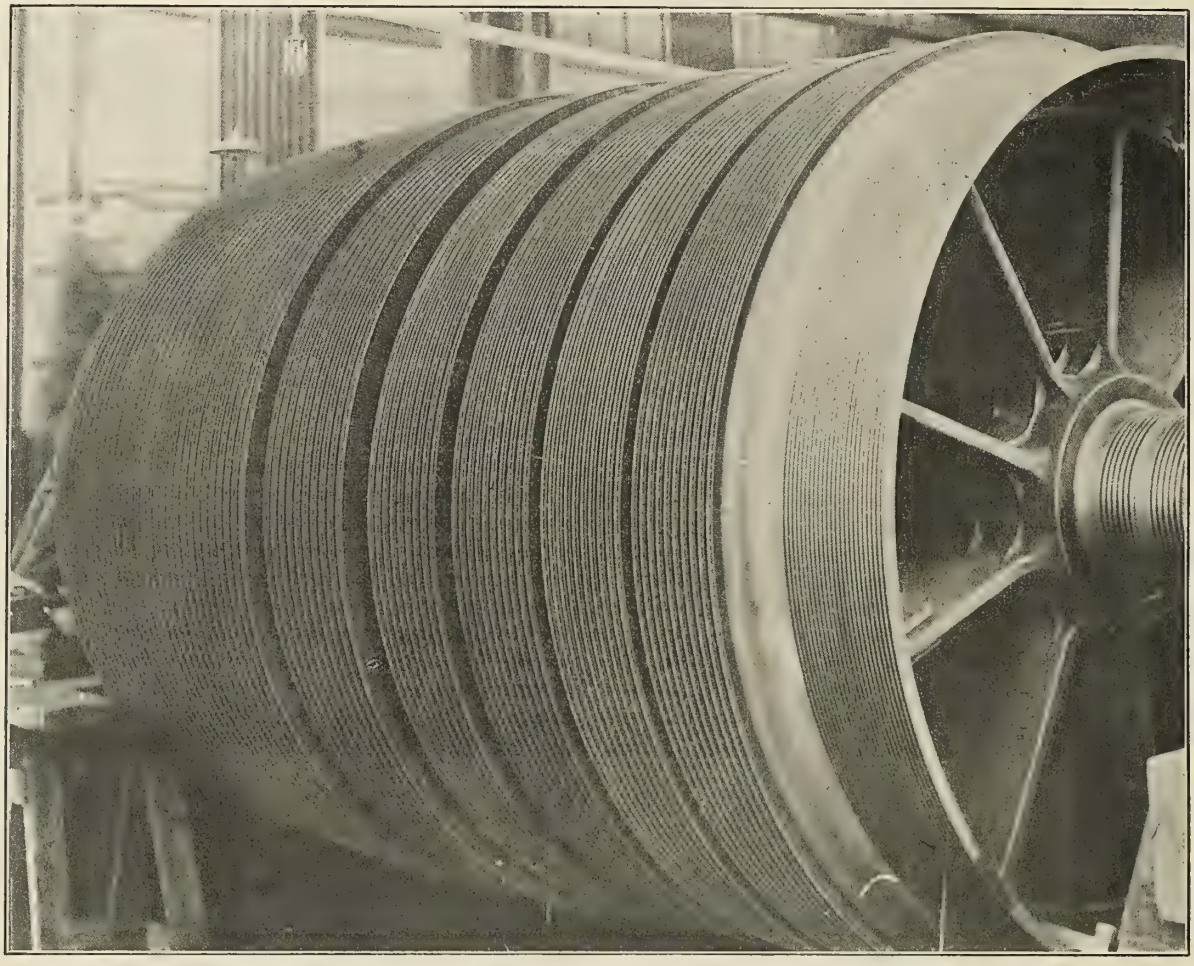


ROYAL MAIL STEAMSHIP VIRGINIAN.

The machinery consists of three Parsons turbines operating separate shafts, each carrying one propeller. The center turbine is high-pressure and each of the two outside turbines low-pressure, and there is a special arrangement, devised by Mr. Parsons, whereby reversing power almost equal to the forward propelling power can be imparted to the low-pressure turbines. The *Victorian* is designed in this way to surpass the ordinary twin-screw steamer. The arrangement of the propellers, and the rapidity with which power can be directed on each of the outer shafts separately in either direction, give the vessel great maneuvering ability.

The second steamer, *Virginian*, which was built on the Clyde by Messrs. Alexander Stephen & Sons, of Glasgow, is a sister ship to the *Victorian*, but the boats are not exactly alike. They are of the same general dimensions, and they are built to the same

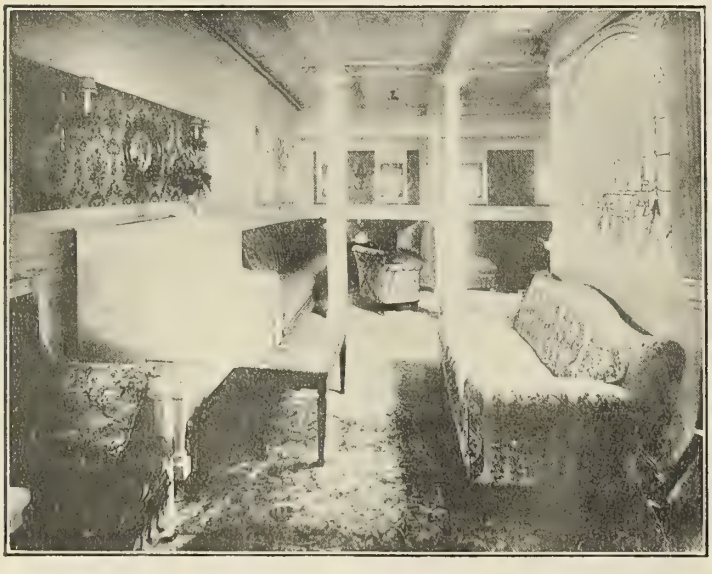
(Copyright, 1905, by Marine Engineering, Inc., New York.)



THE ROTOR OF ONE OF THE TURBINES, SHOWING THE 750,000 BLADES OR VANES.

coefficient, but the Allan Company allowed the builders scope for showing their individual ability. The relation of the horsepower of the boilers to the engines is not quite the same in both, so that the results may throw some further light on the efficiency of turbine machinery. A notable difference to the onlooker is in the funnels. The *Victorian's* is oval, while that of the *Virginian* is round.

The *Virginian* ran trials on the Firth of Clyde just about the time the *Victorian* was due to arrive at Halifax on her first voyage across the Atlantic. The *Virginian* was designed from the first for turbine machinery, while the *Victorian* was intended originally to have reciprocating engines, and it was only after the hull was partially built that the owners decided to install turbines. This helps to account for the advantage in speed which the *Virginian* has shown on trial, but the boiler power of the vessels is also a factor. The turbines of the *Victorian* were supplied by the



MUSIC ROOM ON VICTORIAN.

DINING SALOON ON VICTORIAN.

THE TURBINE STEAMSHIP VICTORIAN.

builders, while those of the *Virginian* were supplied by the Parsons Company. The *Victorian* on her trials on the Clyde did 19½ knots with the engines running 260 revolutions and indicating about 12,000 horsepower, while the *Virginian* made 19.8 knots with engines running 280 revolutions and indicating about 12,500 horsepower. The horsepower is approximate, but the figures estimate as nearly as possible the power that would have been developed by reciprocating engines driving the same vessels at the same speed and under the same conditions. The original speed aimed at was only 17 knots, so the vessel has more than realized expectations. The almost entire absence of vibration was specially noted by those on board. She was absolutely motionless at all speeds, except quite near to the stern, where there was a slight tremor from the dynamos and the propellers, so slight that it was hardly noticeable.

Further difference exists between the *Victorian* and the *Virginian* in the passengers' quarters. The first-class saloon of the *Virginian* is a square apartment, decorated in Georgian style with mahogany paneling, and with a large number of small tables suitable for parties. The floor is laid in oak parquetry. The beam casing of the ceiling is in polished hardwood, and the panels are decorated with lincrusta. The dome is paneled in hardwood with an alcove all round filled in with fibrous plaster sea figures decorated with electric lamps, and having an ornamental brass grille. The music room is paneled and finished in enameled wood and waxed mahogany, with ornamental panels of silk tapestry. The saloon and the music room have each a fine, open fireplace, which is not the case on the *Victorian*. The special suites of rooms consist each of a bedroom and a state room, while some of them have also a bath room. The walls of these rooms are paneled with silk. Each suite is different from the others, there being green rooms, blue rooms, and red rooms. One feature of the suites is that each may, if desired, be taken by one passenger, in which case one of the two beds folds away out of sight. The library and writing room, smoking room, and nursery are specially fitted up in artistic and comfortable manner.

FIRST-CABIN SMOKING ROOM.

## The Position of Warrant Machinist; His Duties, and Opportunities in the Navy.

BY W. M., U. S. N.

It is a common thing for brothers in the engineering profession in civil life to ask: "What kind of a position do warrant machinists occupy in the Navy? What are the requirements? To what engineer officer are warrant machinists responsible? What are the duties, pay, etc.?"

The advent of the warrant machinist came with the navy reorganization bill of 1899, which abolished the engineer corps by consolidation with "the line." The same bill authorized the appointment of 100 warrant machinists, which number has since been increased to 180, but is still only about one-half that equal to the demand. Owing to this scarcity, none have been available for gunboats or destroyers.

The following extracts from the Navy Regulations will give a fair idea of the qualifications:

"Vacancies in the list of warrant machinists shall be filled by competitive examination before a board ordered by the Secretary of the Navy, and open to all machinists in the Navy, and machinists of good character, not above thirty years of age, in civil life, authorized by the Secretary of the Navy to appear before the board.

"With applications from machinists in the Navy there must be statements of opinion of the commanding officer and engineer officer under whom the applicant is serving. These opinions will be limited to the question of whether the applicant is regarded as qualified for the position of warrant machinist and worthy of such advancement.

"Applicants from civil life must furnish testimonials of good moral character and correct habits, and certificates showing experience in machine shop, and in the engine room of a steamer. . . . No applicant from civil life will be examined who is not a machinist by trade, and has not had the care and management of the steam machinery of a sea-going vessel in regular service."

These examinations, which are held annually in September, embrace a general knowledge of the engineering business, such as is gained by all practical engineers through their trade as a machinist, their earlier experience at sea, and probably through the use of a considerable quantity of "midnight oil" applied as a lubricant to the mental wearing surfaces.

### SEA DUTIES.

The regulations specify the following duties for warrant machinists:

"They shall act as assistants to the engineer officers of the ship in all that relates to the care and maintenance of the machinery, boilers, and appurtenances; and shall perform such duty as may be assigned them.

"They shall stand regular watches, in not more than four watches. Routine duties in connection with the surveillance, care, and efficient condition of the machinery, boilers, and mechanical appliances will be assigned them by the senior engineer officer."

The watch duty of the warrant machinist is similar to the usual duties of the assistant engineer in the mercantile marine, but possibly the former has a larger sphere of duty. Having responsible subordinate machinists in charge of each main engine, his presence is not constantly required at the throttle, which permits him to exercise more oversight throughout the department. He is required to be at the engines, however, at all times when they are being operated upon entering or leaving port. The engine-room watch in warships of the first and second class consists of one warrant machinist, one machinist in charge of each engine, two oilers in each engine room, one store keeper, and one coal passer detailed as messenger. In vessels having four warrant machinists their watches are "dogged" every evening, thus avoiding that fatiguing experience of having the "mid-watch" for a week.

The care, maintenance, and repair of the machinery in warships is apportioned among the warrant machinists as follows:

Senior in rank, starboard engine room and contents. Second in rank, port engine room and contents. Third in rank, fire rooms and contents. Junior, all auxiliary machinery outside of engine and fire rooms, including steam launches, distilling and refrigerating plants, winches, etc.

In port warrant machinists perform "day's duty." The tour of duty begins at 8:00 A.M. and continues for twenty-four hours, though it is permissible to "turn in" from 9:00 P.M. to 5 A.M., but subject to call at any time. During the day the officer on duty is responsible for the execution of all orders and carrying out of all work in the department, though he may be relieved from many details by reason of such details coming under the direct responsibility of the other warrant machinists to whose "station" the work belongs. He carefully records in his log all work performed during his "day's duty," which is finished the following morning by carrying out the morning routine work from 5:00 to 8:00 A.M.

With four efficient warrant machinists, the practical engineering duties can be well performed without overtaxing that patience and endurance so essential to the faithful performance of engineering work, especially in tropical climates.

The senior engineer officer to whom warrant machinists are responsible is usually a lieutenant commander or lieutenant; a brilliant and refined type of gentlemen, and mostly a discreet and considerate officer. In battleships and large cruisers he is usually assisted by one lieutenant or ensign. Neither of these officers stands sea watch; each confines his duties to the more scientific engineering problems, the surveillance of the engineer's division, and general direction of the engineering department. As a general thing the warrant machinists are allowed the freedom of their own ideas in pursuing the mechanical methods which practice has proclaimed most successful to the practical engineer.

### SHORE DUTY.

It is an unwritten rule in the Navy, in time of peace, that three years' sea duty constitutes a "cruise," after which officers are assigned to shore duty for such period as the exigencies of the service will permit. This period is usually about two years, in the case of most warrant officers, which is an agreeable relaxation from life on board ship. On shore, warrant machinists are assigned as assistants to the engineering officers at navy yards, where their duties consist of detail work in connection with vessels building or under repair. They are also assigned as assistants to the naval inspectors at private shipyards where war vessels are under construction; and they act as assistants to the inspectors of material at various places where naval material is manufactured.

Unfortunately, however, owing to the limited number of warrant machinists in proportion to the demand for their services at sea, they have not enjoyed as much shore duty as other warrant officers. It is hoped steps will soon be taken to remedy this defect through proper legislation. At present the increase is limited by law to twenty appointments yearly. This fact, combined with the knowledge that warrant machinists obtain comparatively little shore duty, tends greatly to retard the healthy growth of the corps.

### PROMOTION.

1. Boatswains, gunners, and warrant machinists having four years' service as warrant officers, and being under thirty-five years of age, are eligible for promotion to ensign, and are then in line of promotion to highest rank.

2. All warrant officers (except warrant machinists, for whom it is hoped the law will provide at an early date) are, after six years' service as warrant officers, eligible for commission as "chief" in their respective grades, "to rank with, but after, ensign."

The examination for ensign embraces navigation, seamanship, ordnance, and steam engineering, and is not beyond the attainment of one having a good common-school education who becomes a warrant officer under thirty years of age. Of ten warrant officers who successfully passed this examination in 1904, three were machinists.

Promotion to "chief" grade is made upon physical and moral fitness; a satisfactory showing in the efficiency reports during the previous six years; and upon passing an examination in a few subjects in which much care, judgment, and responsibility are involved. This promotion carries the distinction of a commission, and the pay of an ensign, but "does not include additional right to quarters, nor to command." Its main advantage is the increase of pay after reaching the maximum, which is shown as follows:

| | |
|---|---|
| Highest sea pay of chief grade | $1,960 |
| " " " " warrant officer, with ration | 1,908 |
| Increase | $52 |
| Highest shore pay of chief grade, with allowance | $2,248 |
| " " " " warrant officer, with allowance | 1,888 |
| Increase | $360 |

### PAY.

The sea pay of warrant machinists ranges from $1,200 to $1,800 per year, depending at date of appointment upon whether

appointed from civil life, or from the Navy, with previous service. Those appointed from the Navy advance as follows: after three years' service, $1,300; six years, $1,400; nine years' service, $1,600; twelve years' service, $1,800; or maximum pay of warrant officers. Those appointed from civil life are credited by law "at date of appointment, for computing their pay, with five years' service." Thus it will be seen that a warrant machinist appointed from civil life enters on $1,300 per year, and one year later is advanced to $1,400; four years later to $1,600; and seven years later to $1,800. To the yearly sea pay at all times may be added $108 extra allowed for rations. Shore pay is about 10 percent less than sea pay, but the "allowance" is greater on shore than "rations" at sea.

When "incapacitated for the further performance of duty at sea," officers are retired on three-fourths of their sea pay; and at the age of sixty-two, all officers retire on three-fourths pay.

The position of warrant machinist in our Navy corresponds to that of artificer engineer in the British Navy. The latter, however, obtain recognition of their engineering ability through a suitable title, and are also in line of promotion to engineer ensign, engineer lieutenant, etc. The artificer engineer corps in that navy consists of about 300 officers, and so successful have they proved that the British Admiralty has provided for an increase to 800.

---

**An English writer** quoted in Consular Reports says: "The highest ambition of those who aim at speed is to exceed a speed in knots greater than the square root and a quarter of the vessel's length. The Atlantic liners cannot do it; motor boats and the torpedo-boat destroyer can, but such speed is attainable only at enormous extravagance."

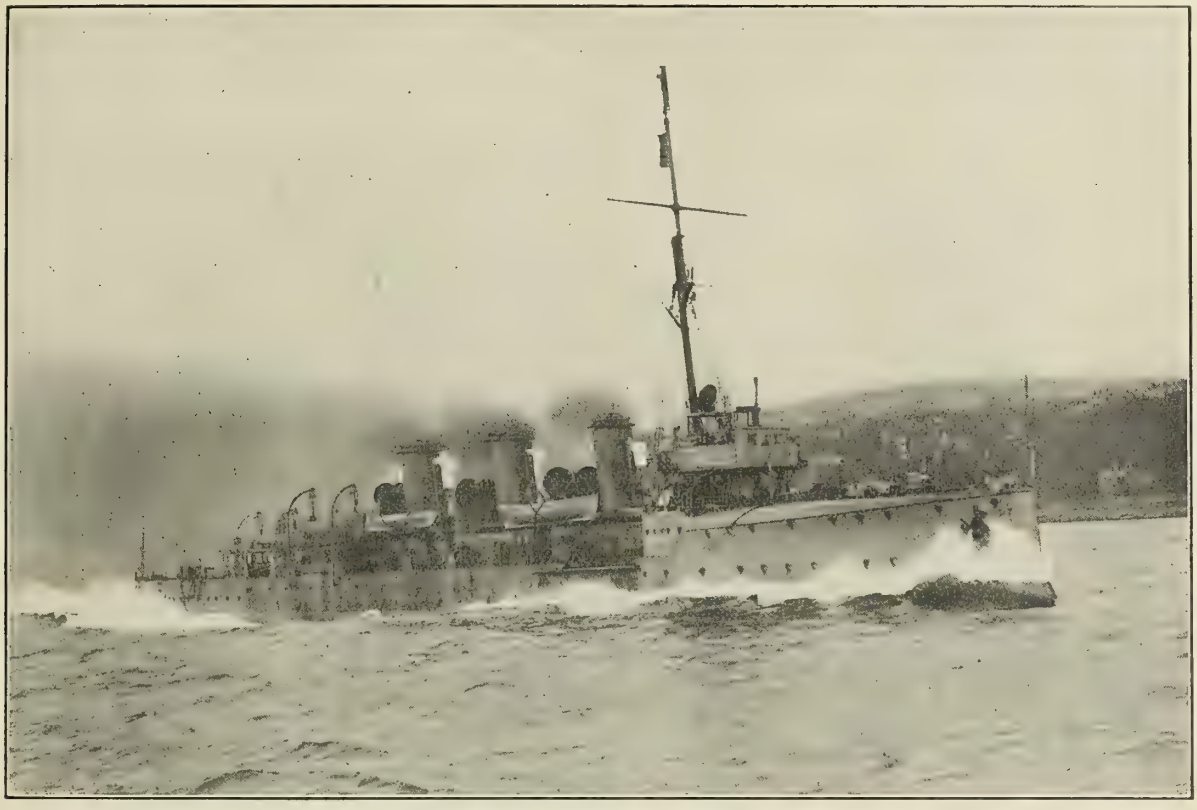
England has 31 ocean steamers of more than 12,000 gross tons each; Germany has 14, the United States 6, Holland 3, France 1, and Belgium 1. The total tonnage of these 56 ships is 840,521.—*Iron Age.*

## THE ENGLISH SCOUT-CRUISER SENTINEL.

BY EMILE GUARINI.

The *Sentinel,* illustrated herewith, and designed, built, engined, and armed by Vickers Sons & Maxim, Ltd., is the first of the new scouts built for the British Navy. The scouts are armed with ten 12-pounder and eight 3-pounder guns, and have two tubes on deck for firing the larger size of torpedoes. A destroyer could not, therefore, stand up against such a ship, and the scouts will always have speed to run away from a formidable enemy. Speed, therefore, is the primary requirement in these craft, and when 25 knots was suggested it was arranged that this should be maintained under adverse weather conditions. This, therefore, necessitated ships of good sea-keeping qualities, and the performance of the *Sentinel* on her series of trials has proved that this ship meets this as well as other essential conditions.

In fact, it can be said that no ship has had to undergo a more



THE SENTINEL MAKING 25¼ KNOTS ON TRIAL TRIP.

searching test than that involved by the eight hours' trial at full speed. It is true that a run of similar duration is prescribed for battleships and cruisers, but in their case there is not the same limitation in regard to weight. In a battleship the units of power of the engines, as a rule, are about equal to tons of displacement; in cruisers the ratio is seldom more than 1¾ indicated horsepower to 1 ton; but in the scouts, typified by the *Sentinel,* the power is equal to 5¾ indicated horsepower per ton, even including in tonnage all the coal, ammunition, and stores for war service; so that it will be realized that the maintenance of such a high speed as 25 knots at sea for eight hours is a particularly severe condition. This speed, however, was easily exceeded, the actual average rate being 25¼ knots, which has never before been reached by any vessel larger than torpedo craft; and, moreover, it is said to be attained without any alteration either in the trim of the ship, in the form or pitch of propeller, or in the machinery arranged for in the design.

The *Sentinel* is a vessel of 340 feet in length and 2,920 tons displacement; she has a high forecastle, to meet heavy seas, but

otherwise lies low in the water, so that she will not be seen from the deck of the enemy's ship beyond eight miles radius. At the same time she has a very high bridge, higher almost than the three funnels, so that a good lookout may be kept. She is well divided by bulkheads, and the scantlings are much heavier than is usual in such high-speed craft.

The trials prescribed by the Admiralty were that the vessel should steam for 96 hours at cruising speed, and that the rate of coal consumption on the latter half of this run should determine the quantity of fuel to be carried when the vessel was running at full speed to enable her to travel 1,500 miles. With this allowance of coal and a load equivalent to the prescribed weight of ammunition, etc., the vessel was required to steam for eight hours at 25-knots speed.

THE SENTINEL ENTERING THE WATER.

At the beginning of this trial the vessel had to steam six times over the measured mile within a period of one hour and a half, and the average revolutions per minute made by the machinery during this time had to be maintained for the remainder of the eight hours. This insured that the speed throughout the whole of the eight hours would be 25 knots.

The first official test was carried out under very severe weather conditions, a gale blowing for three-fourths of the time, so that the vessel was well tested so far as seaworthiness was concerned, and the naval officers in charge spoke well of her behavior. The most important point of the trial had reference to the coal endurance, and it was found that the consumption per knot was practically 2 cwt. One ton was sufficient to carry the ship for 11 sea miles. This determined the load of coal which had to be carried on the full-power trial as about 140 tons.

Two preliminary runs were made over the measured mile, and everything being in order the official trial began. The first procedure was to make six runs over the measured mile at Skelmorlie. The first and second runs were made at low water with a slack tide, and it is suggestive alike of the precision with which the results were taken and of the regular working of the engines that the difference in time between the two runs was only six-tenths of a second. On the subsequent runs tidal influence came in, but the third and fifth runs, which were made against the tide, differed in time by only four-tenths of a second, while the two runs with the tide were made in exactly the same time, viz., 2 minutes 24.4 seconds. This meant practically no variation in engine revolutions, the mean power being about 17,500, while the mean of mean speeds was 25¼ knots. In conformity with the contract the vessel then proceeded down the Firth, the engines maintaining for a further 6½ hours the same number of revolutions.

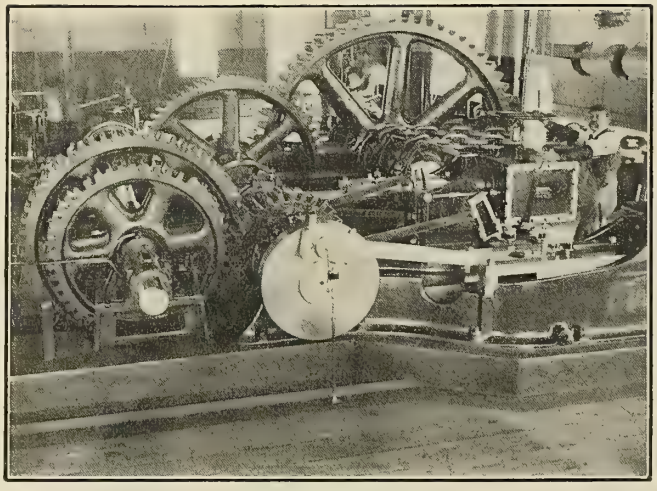
## The Southern Pacific Company in Marine Work.

BY W. H. CRAWFORD AND T. B. BURNITE.

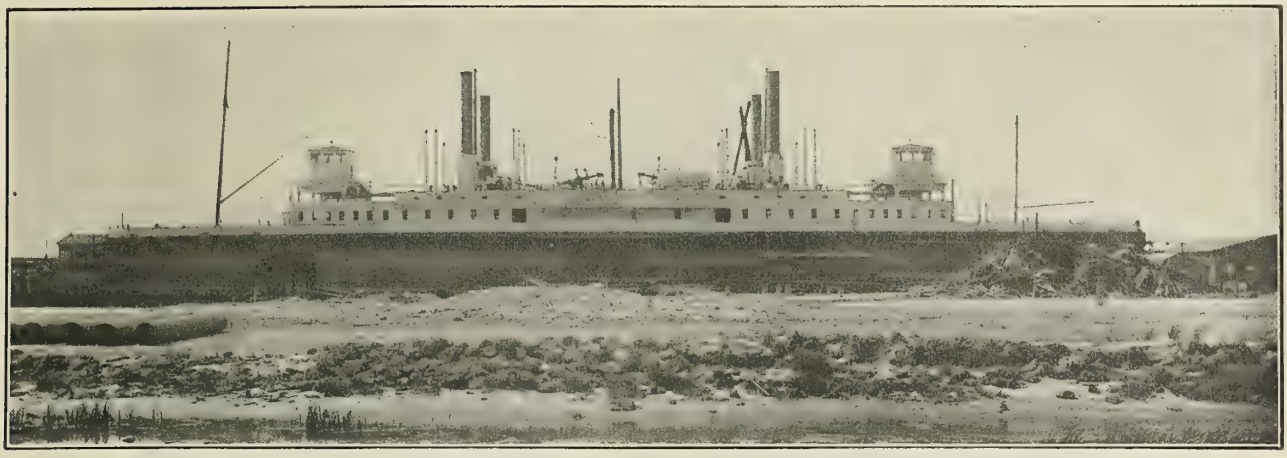
The waters of San Francisco Bay have come prominently before the public during the last few years in many ways. Attention was particularly drawn toward the metropolis of the Pacific Coast when the United States government began operating a regular line of transports between San Francisco and the Philippine Islands. The great opportunity for interesting development in marine matters is now at hand, on account of the immense population that is centering on the shores of this bay within a radius of ten miles from San Francisco, and in every direction.

There are already five separate companies operating large ferry steamers, the latest being the "Key Route." This company has just put into service its third boat, the *San Francisco,* which was fully described in the March number of Marine Engineering (page 111). The Southern Pacific Company is the oldest line, and it is with particular reference to one of the twelve large ferry steamers operated by this company that attention is now called—to what is said to be the largest ferry steamer in the world. The majority of the boats of this company operate between Oakland, the rail terminus of the trans-continental line, and San Francisco, the actual terminus, lying 4 1-2 miles across an arm of the bay.

There is a gap in the rail line, however, about thirty miles east of Oakland, at the head of San Francisco Bay, where the waters of the Sacramento River make a formidable obstacle. When the trans-continental line was put through, it was decided to fill in this



THE HOISTING ENGINES.

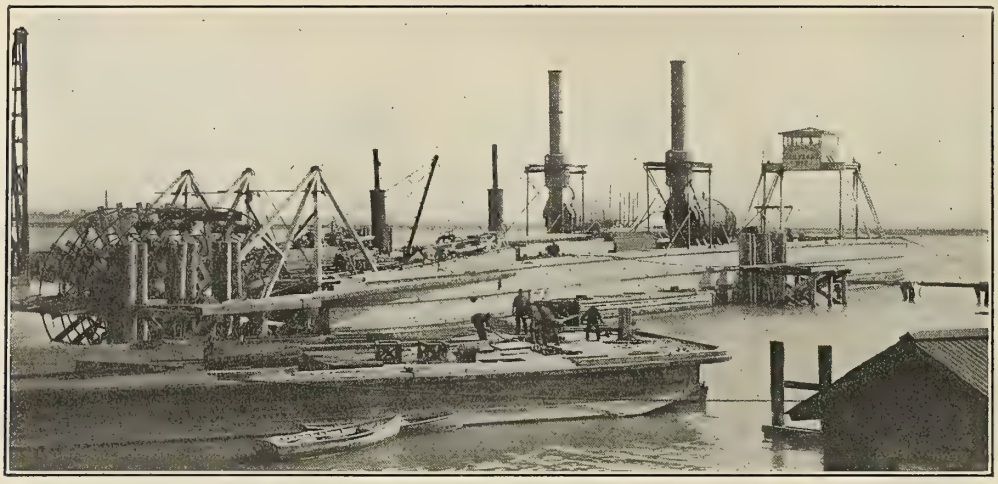


THE FERRYBOAT SOLANO ON SHORE ON THE MARINE RAILWAY.

gap by means of a train ferry, intervening between the opposite shores of what is known as Karquinez Strait. A large boat was designed and built, to transfer bodily all freight and passenger trains, over the mile of water. This was as long ago as 1879, but the boat which was then built at Oakland is still to-day in active service, and is a marvel in more ways than one. The *Solano* went into commission in that year on the one-mile course between Port Costa and Benicia, and has seen continuous service up to date, with the exception of a period of ninety days in 1895, when she was laid up to repair a damaged engine, and for a second period of eighty-two days, now just ended. That a boat of this size could be handled so successfully in the swift running current of Karquinez Strait without any damage save the trouble above referred to, which was the result of a broken piston rod, is a most wonderful record.

On February 5 of this year the *Solano* was taken out of the water and given a general overhauling, the principal item of which was a complete set of new boilers. When the Southern Pacific Company decided on the necessity for this work there was an unusual problem to contend with on account of the length of time required. The only available dry-dock for a boat of this size was so much in demand that its charges were prohibitive, and there was no marine railway on the coast of sufficient size to accommodate the *Solano*. After careful figuring the company decided to build a marine railway for this specific purpose, and ordered the complete railway from H. I. Crandall & Son, of Boston. It was completed, under the supervision of Superintendent McKenzie, at a total cost of about $115,000. One of the illustrations shows the powerful hoisting engines, which are capable of handling 4,000 gross tons, the dead weight of the *Solano*. The railway has an inclination of one-half inch per foot. The *Solano* was docked in forty-one minutes, without mishap of any kind. Two of our illustrations show bow and side views of the big boat as she appeared on the railway just before taking the water again on April 28, after the extensive repairs had been completed. The launching required twenty-one minutes.

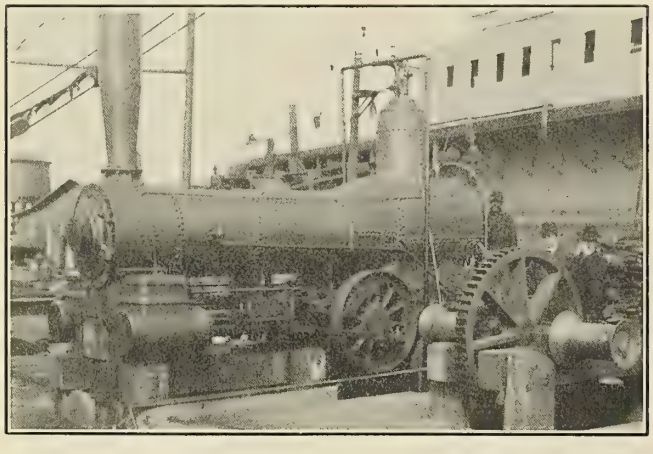
BOW VIEW OF THE SOLANO ON MARINE RAILWAY.



CAR FLOAT NUMBER TWO.

The *Solano* is 450 feet long; 65 feet beam; 116 feet extreme width over guards; 17 feet 8 inches depth of hull; 3,549 gross tonnage; 3,057 net tonnage; and the load draft is 8 feet. The two beam engines which drive the boat are located by the illustration, one operating each paddle wheel. They can be operated independently, this being an absolute necessity on account of the great weight and size of the boat, and the swift currents flowing across her course, which sometimes reach five miles per hour.

The engines, which were built by the Harlan and Hollingsworth Company, of Wilmington, Del., and operate under a pressure of 60 pounds, are of the vertical single-cylinder condensing type, each cylinder being 60 inches in diameter by 11 feet stroke. The indicated horsepower is 2,000. The paddle wheels are 28 feet in diameter with 16-foot buckets. Each shaft is 26 inches in diameter,



A LOCOMOTIVE HOISTING ENGINE.

and extends to the center of the boat, where it terminates in a half-crank, with wrist pin supported by crank and short shaft. This arrangement necessitates the placing of one wheel slightly in advance of the other, as each crank is on the center line of the boat. The stacks, four in number, extend 54 feet above the main deck.

Steam is supplied by eight boilers of the Scotch marine type, aggregating 2,000 horsepower. These boilers were built at the Southern Pacific shops at Sacramento, and are all equipped with oil burners. There is probably no better illustration of the advantages of fuel-oil burning than in the case of the *Solano,* where a saving in the monthly fuel bill of over 68 percent has been made over coal, with the latter at $2.80 per ton. The remarkable saving made with this boat is due largely to the character of service, and not so much to the low first cost of the oil. The distance from slip to slip being just one mile, the burners are lighted immediately before the boat pulls out, and shut off just before she reaches the opposite shore. There is thus no consumption of fuel save when the engines are actually running, and drawing on the boilers for steam.

The *Solano* regularly transports from thirty to forty-five cars and two or three locomotives at a time. The overland trains are placed on the boat and carried across the strait without any delay or inconvenience, many instances being on record where passengers have made the trip without knowing that they had left dry land.

During the present lay-up the *Solano* has received, besides her eight new boilers and other machinery, extensive overhauling to her wooden hull and all pipe work. Altogether about $120,000 has been expended, the first cost of the boat having been about $358,000. During the operations great speed was necessary in order to complete the work in the allotted time of ninety days. This rush has developed many ingenious appliances, among which is the hoisting engine shown by our illustration. This hoist is what is left of an old locomotive, which had seen service for about thirty years. A pinion was placed on the center of the main axle, engaging a large gear on a piece of line shaft about twenty feet long, and extending out beyond either side of the boiler. A second reduction of gears from this shaft supplied the winches with sufficient power to lift 200 tons.

A complete pneumatic tool plant was installed in connection with the marine railway, consisting of an air compressor and numerous drills and hammers, made by the Chicago Pneumatic Tool Company. On the *Solano* all of the spikes were driven with air tools, and the drilling was much simplified in the same way. It is said that the complete installation has paid for itself on this one job, having saved over $5,000 on the original estimate of cost for the work.

While this work has been going on the Southern Pacific Company has also been building a barge, which is the subject of another illustration, and is known as car float *No. 2.* It being necessary at present to transport great numbers of freight cars from the Oakland terminal to points around the bay, a number of car floats have been employed, these being operated by a fleet of steam tugs. It was decided to equip one of the car floats with engines and boilers of its own, and the installation is seen to be rapidly nearing completion.

It is a well-established fact that greater speed and economy can be attained by the new arrangement, both in actual running time, and in maneuvering at terminals. The main point of advantage, however, in these self-propelled boats, lies in the remarkably shallow load draft. Car float *No. 2* requires but 5 feet, which permits

her to run safely along nearly any portion of the bay shore, where the tugs drawing 18 feet are at a disadvantage. San Francisco Bay is also subject, at times, to very rough weather, when ordinary tugs with cargoes in tow have difficulty in making headway. The new self-propelled car float will be better able to face a hard blow.

THE LAUNCH OF THE SIENA, WITH STEAM UP.

## The Launch of the Italian Twin-Screw Steamship Siena.

BY DAGNINO ATTILIO.

On April 29, the new ship *Siena*, for the transatlantic trade, was sent into the water by the Odero Shipbuilding Company. The *Siena* is of the spar-deck type and is rated 100 A1 by the Italian Register and the German Lloyds. She is fitted with both first cabin and third-class accommodations and has a considerable capacity for cargo. The *Siena* much resembles the *Toscana* and the *Ravenna*, which are in the Rio Plate service of the same line, and is rigged with two pole masts and one funnel. The midship deck house extends between the masts. The cargo hatches are near the masts in the "break" of the deck.

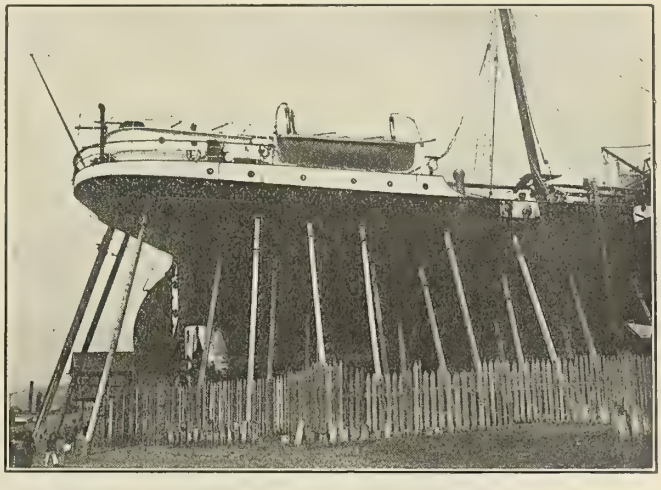
The first-class accommodations are located in the deck house amidships on the bridge and shelter decks, while the forward end of the boat deck, as well as the sides of the two decks next below, are set aside as a promenade. The accommodation has been worked out on an elaborate scale, with decoration largely in carved mahogany and white enamel finish, and the furniture in dining saloon, music room, and ladies' parlor is very rich. The capacity for first-class passengers numbers 80, while provision is made for 1,400 of the third class.

The ventilation has been carefully worked out with an idea of using natural ventilation wherever possible. Illumination is, as usual, by electricity, and very complete. The pantries and galley are amidships, and so arranged and ventilated as to offer the passengers no inconvenience even in tropical climates.

In connection with the hull, new features have been introduced in the shape of a stern post in three pieces riveted together, the upper and lower pieces being of forged steel and the middle piece of cast steel, the latter forming a solid body with the propeller-shaft brackets.

The ship has a length over all of 400 feet, a length between perpendiculars of 380 feet, an extreme beam of 46 feet 6 inches, a depth of 29 feet 6 inches, and displaces 8,050 tons. She is propelled by two triple-expansion engines with cylinders 19⅜, 32¾, and 55⅛ inches in diameter, and a common stroke of 39⅜ inches. The percentage of the stroke at which steam is cut off in the high-pressure cylinder is 75; intermediate, 68; and low, 64. With 85 revolutions per minute 3,000 horsepower is developed, this giving a speed of 14.5 knots. There are two double-ended Scotch boilers, each having a diameter of 12 feet 7½ inches, and a length of 21 feet 5 inches; each contains two furnaces in each end, of a mean diameter of 46½ inches. The total grate surface is 83.5 square feet, and heating surface 3,498 square feet; this gives a ratio between the two of 41.9 to 1. The working pressure is 210 pounds.

The propellers are four-bladed, with a diameter of 14 feet and a mean pitch of 17 feet 2 inches; this gives a pitch ratio of 1.23, while the projected surface is 48 square feet and the developed surface of each propeller 59.5 square feet. The crank shaft and pins have a diameter of $11\frac{7}{16}$ inches, while the line shaft is reduced to $10\frac{5}{8}$ inches and the propeller shafting increased to $12\frac{3}{8}$ inches. There are five thrust rings, giving a total of 760 square inches of thrust surface. The piston rods have a diameter of $5\frac{5}{16}$ inches, crosshead pins $5\frac{11}{16}$ inches, and connecting rods $5\frac{5}{16}$ inches. The latter measure $84\frac{5}{8}$ inches between centers. The air pumps are of the Edwards type, with a diameter of 18½ inches and a stroke of 19¾ inches. The centrifugal circulating pump has a rotor diameter of 31½ inches, and is operated by an engine with



STERN OF THE SIENA ON THE WAYS.

cylinder measuring 6¾ by 6¾ inches. The feed pump measures 3⅛ by 19¾ inches. There are two main condensers, with cast-iron shells, having a total cooling surface of 1,938 square feet distributed over 572 tubes with a diameter of ¾ inch and a thickness represented by No. 17 B.W.G. The length between tube plates is 15 feet 5 inches.

ABSTRACT ENGINEER'S LOG, S. S. AUSTRALIA, VOYAGE NO. 3, BOUND WEST.

| | | |
|---|---|---|
| EASTBOUND | Leaving: New York ..... I<br>..... A.M.<br>..... P.M. | Passing Sandy Hook Lightship: .....I<br>.....A.M.<br>.....P.M. |
| WESTBOUND | Leaving: Southampton.....Feb. 13, 1905.<br>.....A.M.<br>.....12.1 P.M. | Passing Needles: ..... Feb. 13, 1905.<br>.....A.M.<br>..... 1.32 P.M. |

| | Dates. | | | Time. | | | | | Average Steam Pressures. | | | | | | | Vacuum. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Day of Week. | Month. | Day of Month. | Length of Day in Hours and Minutes. | Hours Steam Up. | Hours Steaming. | | | Boilers. | 1st Receiver. | | 2d Receiver. | | 3d Receiver. | | Condenser. | |
| | | | | | | | | | | Port. | Stb'd. | Port. | Stb'd. | Port. | Stb'd. | Port. | Stb'd. |
| 1 | Tuesday..... | 1905 February. | 14th | 24′ 53″ | 24′ 53″ | 19′ 48″ | ..... | ..... | 196 | 93 | 89 | 38 | 40 | 8 | 7 | 25 | 24¾ |
| 2 | Wednesday..... | | 15th | 24′ 51″ | 24′ 51″ | 24′ 51″ | ..... | ..... | 202 | 95 | 91 | 40 | 42 | 8 | 8 | 25 | 25 |
| 3 | Thursday..... | | 16th | 24′ 49″ | 24′ 49″ | 24′ 49″ | ..... | ..... | 200 | 95 | 90 | 38 | 42 | 8 | 8 | 25 | 25 |
| 4 | Friday..... | | 17th | 24′ 42″ | 24′ 42″ | 24′ 42″ | ..... | ..... | 196 | 93 | 90 | 38 | 41 | 8 | 8 | 25 | 25 |
| 5 | Saturday..... | | 18th | 24′ 41″ | 24′ 41″ | 24′ 41″ | ..... | ..... | 200 | 94 | 90 | 39 | 42 | 8 | 9 | 25 | 25 |
| 6 | Sunday..... | | 19th | 24′ 43″ | 24′ 43″ | 24′ 43″ | ..... | ..... | 202 | 96 | 92 | 39 | 43 | 9 | 9 | 25 | 25 |
| 7 | Monday..... | | 20th | 21′ 39″ | 21′ 39″ | 15′ 01″ | ..... | ..... | 201 | 96 | 90 | 39 | 42 | 9 | 9 | 25 | 25¼ |
| 8 | ..... | | .... | ..... | ..... | ..... | ..... | ..... | ... | .. | .. | .. | .. | .. | .. | .. | .. |
| 9 | ..... | | .... | ..... | ..... | ..... | ..... | ..... | ... | .. | .. | .. | .. | .. | .. | .. | .. |
| 10 | ..... | | .... | ..... | ..... | ..... | ..... | ..... | ... | .. | .. | .. | .. | .. | .. | .. | .. |
| Totals and averages..... | | | ..... | 170′ 18″ | 170′ 18″ | 158′ 35″ | ..... | ..... | 200 | 95 | 90 | 39 | 42 | 8 | 8 | 25 | 25 |

| Summary of Coal Consumption. | | |
|---|---|---|
| Remaining on board from passage... | .... | 410 |
| Received on board at Southampton | .... | 2,188 |
| Total remaining and received | .... | 2,598 |
| Consumed in port | 180 | |
| Coal used laying fires, raising steam, lying in river | 56 | 236 |
| Total on board, leaving | .... | 2,362 |
| Coal used between New York and Sandy Hook | 70 | .... |
| Coal used between Needles and Southampton | 15 | .. |
| Consumed in main boilers on sea passage | 1,807 | .... |
| Consumed for other purposes on passage | 15 | 1,907 |
| Remaining on arrival at New York | 1,907 | 455 |
| Kind of Coal | .... | .... |
| Quality | .... | .... |

| Details of Coal Consumption. | | |
|---|---|---|
| Consumed in port includes, below: | | |
| Main boilers | 180 | .... |
| Donkey boilers | .... | 180 |
| Galleys | 10 | .... |
| Coal used in laying fires, etc., includes, below: | | |
| Laying fires | 31 | .... |
| Raising steam, etc | 15 | 56 |
| Lying in river | .... | .... |
| Coal used between New York, etc., includes below: | | |
| Consumption in main boilers between New York and Sandy Hook | 70 | .... |
| Consumption in main boilers between Needles and Southampton | 15 | 85 |
| Consumed for other purposes includes. | | |
| Donkey boilers at sea | .... | .... |
| Galleys at sea | 15 | 15 |
| | 336 | |

## THE LOG OF A LINER.

The log of a first-class liner is usually protected from the eyes of the public, and the necessary and important facts contained therein kept a strict secret. The majority of logs are, as a general rule, condensed down to the required amount on arrival at headquarters, or shore technical department, and entered accordingly in the half-yearly report, which eventually finds its way to the manager's sanctum. The casual glance from a visitor, or an engineer with no marine experience, at the log of a chief engineer of one of the crack liners, would undoubtedly astonish him, and greatly increase his respect for the staff below. Even to an experienced "tramp" engineer the amazing accumulation of figures would appear almost incredible for a six-and-a-half days' run, but the data contained therein is absolutely essential to the official staff if they are to get facts concerning the efficient working of the engines. Some of the liners crossing the Atlantic carry as many as 15 to 22 engineers, including electricians, refrigerating, and deck engineers; but, I can safely say, only one, or possibly two, in each ship can fill up a log according to the requirements of the theoretical staff of the various lines. Stating a case of a liner that recently left England, the chief engineer had a vacation for one voyage, but before leaving the ship discharged his clerk, who had apparently during the voyage misconducted himself. The senior first assistant was of course promoted to chief engineer, and under the circumstances had to engage a new clerk. On arriving at the home port again the log was forwarded to the office; but the figures and data were decidedly inaccurate, and naturally so, because the man had not had a chance for probably five or six months to see the chief's log at all.

So, for the future benefit of junior engineers, this article is written; a typical modern liner is taken, and all the calculations are from actual practice. Some decimals are worked out to two or three places, others to only one, but quite sufficient for an example. Now the run, or distance, between the Needles and Sandy Hook light vessel, in accordance with the captain's report, is 3,046.5 knots, or nautical miles, and the difference in time between the two places is roughly about five hours; so the ship's clock will have to be put back about 40 to 45 minutes every day, according to the ship's performance. Now if we refer to the log, the number of hours and minutes contained in the first day are 24 hours 53 minutes. So the clock on this day was put back 53 minutes; hence the addition in the first place; but the regular steaming time turned out to be 19 hours and 48 minutes.

Now the next important item running along the first day's line, the 14th of February, is the revolutions per day; the pressures, temperatures, and density, of course, may be had from the gauges, thermometers, and salinometer, so we do not need any calculation. In taking the first day's run, the revolutions for the entire day

ABSTRACT ENGINEER'S LOG, S. S. AUSTRALIA, VOYAGE NO. 3, BOUND WEST.—*Continued.*

| Passing Needles: | Intermediate | Ports. | Arriving Southamgton: |
|---|---|---|---|
| ..... I<br>..... A M.<br>..... P.M. | | | ..... I<br>..... A.M.<br>..... P.M. |
| **Passing Sandy Hook Light Ship:**<br>..... Feb. 20, 1905.<br>..... 2.40 A.M.<br>..... P M. | .... | .... | **Arriving New York:**<br>..... Feb. 20, 1905.<br>..... 9.19 A.M.<br>..... P.M. |

| Air Pressure by Water Column. | | | | Height of Barometer. | Temperatures. | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fan Discharge. | Air Reservoirs. | Ash Pits or Stoke Hold. | | Sea Water. | Feed Water. | | Hot Well. | | Engine Room. | | Boiler Room. | | | | Funnels. | | | Atmosphere. | Gases at Fan Suction. | Air Reservoirs. |
| | | | | | Port. | Stb'd. | Port. | Stb'd. | Port. | Stb'd. | No. 1. | No. 2. | No. 3. | No. 4. | No. 1. | No. 2. | No. 3. | | | |
| .. | 2⅛ | 1⅞ | 1 | 30.03 | 52 | 192 | 196 | 118 | 119 | 89 | 91 | 91 | 88 | 76 | 95 | 400 | 440 | .. | 51 | 102 | 203 |
| .. | 2⅛ | 1⅞ | 1 | 29.93 | 53 | 202 | 200 | 123 | 122 | 97 | 100 | 101 | 95 | 77 | 100 | 450 | 460 | .. | 54 | 104 | 205 |
| .. | 2⅛ | 1⅞ | 1 | 30.29 | 55 | 202 | 201 | 122 | 123 | 94 | 98 | 98 | 92 | 81 | 100 | 440 | 460 | .. | 54 | 106 | 204 |
| .. | 2⅛ | 1⅞ | 1 | 29.67 | 53 | 199 | 199 | 120 | 122 | 87 | 87 | 90 | 90 | 80 | 94 | 450 | 460 | .. | 53 | 104 | 205 |
| .. | 3 | 2¼ | 1¼ | 29.69 | 41 | 199 | 200 | 121 | 121 | 82 | 82 | 79 | 72 | 62 | 83 | 440 | 470 | .. | 36 | 94 | 193 |
| .. | 3 | 2¼ | 1¼ | 29.53 | 46 | 201 | 202 | 121 | 122 | 86 | 88 | 87 | 77 | 65 | 95 | 440 | 460 | .. | 41 | 101 | 201 |
| .. | 3 | 2¼ | 1¼ | 29.84 | 41 | 200 | 202 | 121 | 121 | 80 | 82 | 84 | 81 | 70 | 89 | 440 | 460 | .. | 33 | 100 | 201 |
| .. | .. | .. | .. | ..... | .. | ... | ... | ... | ... | .. | .. | .. | .. | .. | | ... | ... | .. | .. | ... | ... |
| .. | .. | .. | .. | ..... | .. | ... | ... | ... | ... | .. | .. | .. | .. | .. | .. | ... | ... | .. | .. | ... | ... |
| .. | .. | .. | .. | ..... | .. | ... | ... | ... | ... | .. | .. | .. | .. | . | .. | .. | ... | .. | .. | ... | ... |
| .. | 2¾ | 2 | 1⅛ | 29.85 | 49 | 200 | 200 | 121 | 121 | 88 | 89 | 90 | 85 | 73 | 93 | 437 | 458 | .. | 46 | 101 | 201 |

| Oils. | | | | |
|---|---|---|---|---|
| | Eng. Oil. | Cyl. Oil. | Lamp Oil. | Patent Grease. |
| Remaining on board from previous passage.. | 1,389 | 143 | 90 | 220 |
| Received on board at Southampton..... | .... | .... | 360 | .... |
| Total remaining and received..... | 1,389 | 143 | 450 | 220 |
| Oil used in port for various purposes..... | 127 | 12 | .... | .... |
| Oil used in filling cups, etc., leaving..... | 40 | .... | .... | .... |
| Oil used for refrigerating engines..... | 7 | .... | .... | .... |
| Oil used for fan engines... ... ..... | 42 | .... | .... | .... |
| Oil used for electric engines..... | 42 | .... | .... | .... |
| Oil used for main engines on passage..... | 400 | 42 | .... | .... |
| Total consumption..... | 658 | 54 | 150 | .... |
| Remaining on arrival at New York ..... | 731 | 89 | 300 | 220 |

are 103,540, port engine, the minutes actual steaming time 19 hours 48 minutes = 1,188 minutes; therefore we have $\frac{103,540}{1,188}$ = 87.1 revolutions per minute for the port engine; starboard engine is obtained in the same way, viz., $\frac{102,090}{1,188}$ = 85.9 revolutions per minute, as may be seen from the log.

The following column contains data which is closely observed by the "staff," namely, coal, an important matter on a liner. Here we have 212 tons per day. Every portion of a ship's bunker is known to the senior engineers, the spaces in between the stringers, angles, and webs are accurately worked out, and the engineer responsible for his watch is able to give a very reasonable estimate of the coal consumed on his "turn" by simply counting the number of spaces denuded of coal during the four hours, and multiplying the result by the quantity individually held. If various small spaces alongside the boilers hold 35.33 tons, which is all consumed in one watch comprising four hours, then 35.33 × 6 watches equals 211.98 tons, or approximately 212 tons for the first day's run. Of course all watches are not all alike; some consume more than others. Clearing the first day's coal we follow up with ashes. The usual method is to weigh the ash bucket or bag first; then pound or partly crush the clinkers and ash, fill up the bucket, deduct the weight of the bucket from the total or combined weight, and you arrive at the weight of the ashes. Count the number of buckets in one watch and multiply the result by the weight of the ashes. Say that there were 6,720 pounds of ashes in a watch of four hours, then 6,720 × 6 = 40,320 pounds per day, so $\frac{40,320}{2,240}$ = 18 tons, which gives the total amount of ashes in one day's run. The percentage of ashes, called for in the same line, is obtained by the formula $\frac{18 \times 100}{212}$ = 8.4 percent, which is the quantity of ashes in tons per day, multiplied by 100 percent and divided by the coal consumed.

In another column we have the distance by the engines in nautical miles or knots, by the well-known formula:

$$\frac{\text{revolutions of engines} \times 60 \times \text{pitch of propeller}}{6,080 \text{ feet}}$$

Now the mean revolutions, port and starboard engines = $\frac{87.1 + 85.9}{2}$ = 86.5, and the pitch of propeller is 25 feet 9 inches; therefore the formula will run $\frac{86.5 \times 60 \times 25.75}{6,080}$ = 21.98 knots per hour, and the total steaming time is 19 hours 48 minutes. So 21.98 × 19.80 = 435.20 knots per day, which we will call 436 knots to simplify the method. The following two columns we will omit because the result is obtained from the deck, and usually sent down to the chief engineer at noon each day. The slip percent is obtained by formula:

$$\frac{\text{engine knots—ship's knots}}{\text{engine knots}} \times 100.$$

Therefore by the log we have $\frac{436 - 376}{436} \times 100$ = 13.7 percent slip of propeller. Now, taking the last column in the same line, knots per hour equals:

$$\frac{\text{knots by observation}}{\text{hours steaming}};$$

therefore $\frac{376}{19.80}$ = 18.98, in round numbers say 19 knots. That

ABSTRACT ENGINEER'S LOG, S. S. AUSTRALIA, VOYAGE NO. 3, BOUND WEST.—*Continued.*

| Docked and Finished with Engines. | Space for Intermediate Ports. | Sea Passage: Sandy Hook Light Ship to Needles. | | |
|---|---|---|---|---|
| ..... Feb. 20, 1905. | ..... | Needles to Sandy Hook Light Ship. | | |
| .....9.19 A.M. | | | | |
| .....P.M. | ..... ..... ..... | Days. | Hours. | Minutes. |
| | ..... ..... ..... | 6 | 14 | 35 |

| Density. | | | | Expansion. | | | | | | | | Average I. H. P. Combined. | Revolutions. | | | | Coal in Tons per Day. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Water in Boilers. | | | | H. P. Cyls. | | 1st I. P. Cylinder. | | 2d I. P. Cylinder. | | L. P. Cylinder. | | | Total per Day. | | Average per Minute. | | Main Boilers. | Donkey Boilers. | Galley. |
| No. 1. | No. 2. | No. 3. | No. 4. | Port. | Stb'd. | Port. | Stb'd. | Port. | Stb'd. | Port | Stb'd. | | Port. | Stb'd. | Port. | Stb'd. | | | |
| .... | Fresh. | .... | .... | Full. | | Full. | | Full. | | Full. | | .... | 103 540 | 102 090 | 87.1 | 85.9 | 212 | ..... | 3 |
| .... | Fresh. | .... | .... | Full. | | Full. | | Full. | | Full. | | .... | 131,680 | 130,030 | 88.3 | 87.2 | 290 | ..... | 2 |
| .... | Fresh. | .... | .... | Full. | | Full. | | Full. | | Full. | | .... | 131,120 | 129.200 | 88.1 | 86.8 | 290 | ..... | 2 |
| .... | Fresh. | .... | .... | Full. | | Full. | | Full. | | Full. | | .... | 124.630 | 123,730 | 84.1 | 83.5 | 280 | ..... | 2 |
| .... | Fresh. | .... | .... | Full. | | Full. | | Full. | | Full. | | .... | 128,740 | 127,250 | 87.0 | 86 | 280 | ..... | 2 |
| .... | Fresh. | .... | .... | Full. | | Full. | | Full. | | Full. | | .... | 131,990 | 130,230 | 89.0 | 87.8 | 280 | ..... | 2 |
| .... | Fresh. | .... | .... | Full. | | Full. | | Full. | | Full. | | .... | 79,380 | 78,360 | 89.0 | 88 | 175 | ..... | 2 |
| .... | ..... | .... | .... | .... | | .... | | .... | | .... | | .... | ..... | ..... | .... | .... | ... | ..... | .. |
| .... | ..... | .... | .... | .... | | .... | | .... | | .... | | .... | ..... | ..... | .... | .... | ... | ..... | .. |
| .... | ..... | .... | | .... | | .... | | | | | | .... | ..... | ..... | .... | .... | ... | ..... | .. |
| .... | Fresh. | .... | .... | Full. | | Full. | | Full. | | Full. | | 18,661.82 | 831,080 | 820,890 | 87.4 | 86.3 | 1,807 | ..... | 15 |

finishes the day as far as calculation goes. Oils are not taken into account until further on, as the total time has to be taken into account to get the average. The following days are of course worked out under the same rule, and the final result, which reads totals and averages, brings in a few more calculations.

In the first instance we take the actual steaming time between the Needles and Sandy Hook light ship; the total time according to the log is 158 hours 35 minutes. The revolutions for the voyage, port engine = 831,080, and the total steaming time 158 hours 35 minutes, but the stoppage for the pilot (11 minutes) has to be deducted, which brings the time to 158 hours 24 minutes, or 9,504 minutes. Therefore $\frac{831,080}{9,504} = 87.4$ average revolutions for the voyage, for port engine. The revolutions for the starboard engine are $\frac{820,890}{9,504} = 86.3$, and the mean revolutions for both engines equals $\frac{87.4 + 86.3}{2} = 86.85$.

The next item, and a very great one in the eyes of most firms, is coal. The consumption between the Needles and Sandy Hook light ship is 1,807 tons, and the steaming time 158 hours 35 minutes. So $\frac{1,807 \text{ tons}}{158.5833} = 11.39$ tons per hour, and $11.39 \times 24 = 273.36$ tons per day. The percentage of ash requires to be taken next. We have the proportion, 1,807 tons coal : 216 tons ash :: 100 percent = 11.9 percent of ash. The quantity per day will run at $11.9 \times 273.36 = 32.52$ average tons of ash per day. The engine oil used during the voyage for port and starboard engines is 400 gallons. To arrive at the consumption per hour and per day we have $\frac{400}{158.5833} = 2.53$ gallons per hour and $2.53 \times 24 = 60.72$ gallons per day. The cylinder oil is worked out the same way.

We now follow up with the average percentage of slip of propeller for the voyage, which will be (engine knots minus ship's knots) divided by engine knots and the result multiplied by 100. The example on the log will work out at $\frac{3,502 - 3,046.5}{3,502} \times 100 =$ 13.0 percent slip, and the average knots per hour in the next column is the distance traveled by the ship from the Needles to Sandy Hook light vessel, 3,046.5 knots, divided by the actual steaming time, or $\frac{3,046.5}{158.5833} = 19.21$ knots, which corresponds with the data contained in the log. The actual steaming time is 158 hours and 35 minutes, or 6 days 14 hours 35 minutes. This result is counted as the "sea passage"; the total passage, from dock to dock—that is, Southampton to New York—works out at 7 days 2 hours 18 minutes. The result is always obtained from the chief officer and entered on the log.

Now take the summary of coal consumption; the quantity remaining from previous passage, commonly called "old stock," is 410 tons. The total amount received on board at Southampton 2,188 tons; therefore 2,188 plus 410 equals 2,598 tons remaining and received. The coal used in port for working cargo and laying fires ready for starting away is 180 plus 56 equals 236 tons, so the total on board on leaving port is 2,598 — 236 = 2,362 tons. Following upon this we have to obtain the coal consumed between the dock and starting point, viz., Southampton to the Needles, and from finishing point to dock. The consumption from Southampton to the Needles being 15 tons, and Sandy Hook light vessel to New York 70 tons, the consumption between the Needles and Sandy Hook 1,807 tons, and 15 tons total consumption for the galleys, the amount is 1,907 tons. Now the total on board at Southampton, 2,362 tons, minus the consumption, 1,907 tons, will leave 455 tons, which will naturally be the "old stock" on the termination of the voyage. The total consumption of coal from dock to dock is 180 + 56 + 70 + 15 + 15 equals 336 tons plus 1,807, the consumption between points equals 2,143 tons.

The average indicated horsepower is arrived at by a method known to very few on board ship. The formula runs.

$$\frac{(\text{average rev. for the voyage})^3 \times (\text{total I.H.P. from cards})}{(\text{revolutions when cards are taken})^3}$$

= average I.H.P., so with the example we have $\frac{86.85^3 \times 19,413}{88^3}$ = 18,661.82 = average I.H.P.

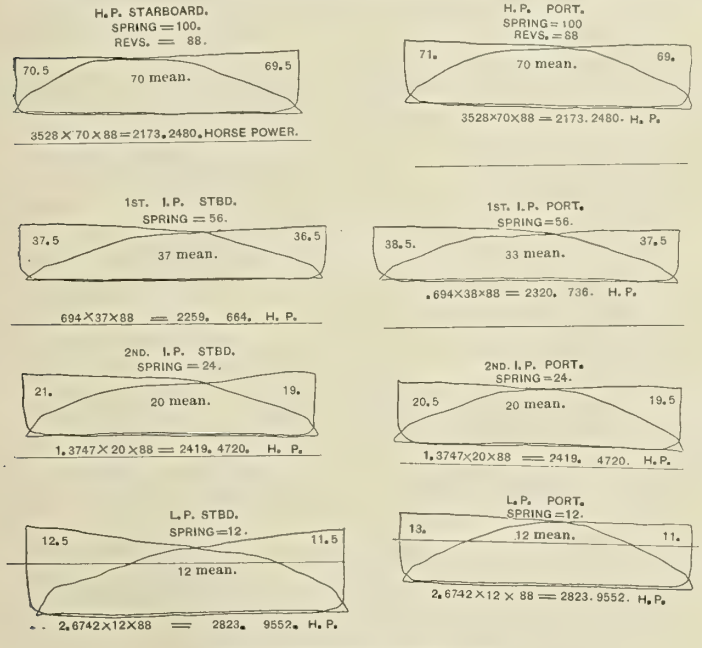
Far and away the most simple method of working out indicator cards is by the planimeter. Both the areas and mean effective pressures are accurately and quickly ascertained without the usual method of figuring and working out each card by ordinates. The set of cards shown was taken during the run from the Needles to

ABSTRACT ENGINEER'S LOG, S. S. AUSTRALIA, VOYAGE NO. 3, BOUND WEST.—*Concluded.*

| Passage: New York to Southampton. / Southampton to New York. | | | Draft, Leaving. Forward. | | Aft. | | Draft, Arriving. Forward. | | Aft. | |
|---|---|---|---|---|---|---|---|---|---|---|
| Days. | Hours. | Minutes. | | | | | | | | |
| 7 | 2 | 18 | 26′ | 8″ | 27′ | 4″ | 24′ | 0″ | 25′ | 0″ |

| Ashes in Tons per Day. | | | Oils. Gallons of Oil per Day. | | | | Distances per Day. | | | Slip per Cent. | Knots per Hour. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boiler Rooms. | Donkey Boiler. | Per-centage of Ashes. | Engine. Port. | Engine. Stb'd. | Cylinders. Port. | Cylinders. Stb'd. | By Engines. | By Observation. | By Log. | | | |
| 18 | .. | 8.4 | 25 | 25 | 3 | 3 | 436 | 376 | 376 | 13.7 | 19 | Light head wind and head sea. |
| 32 | .. | 11. | 30 | 30 | 3 | 3 | 555 | 486.2 | 486 2 | 14.4 | 19.6 | " " " " " " |
| 34 | .. | 11.7 | 30 | 30 | 3 | 3 | 552 | 481.4 | 481.4 | 12.7 | 19.4 | " " " " " " |
| 36 | .. | 12.8 | 30 | 30 | 3 | 3 | 526 | 443.6 | 443.6 | 15.6 | 18.0 | Strong head gale. |
| 33 | .. | 11.7 | 30 | 30 | 3 | 3 | 543 | 457.5 | 457.5 | 15 7 | 18.5 | Fresh head wind and sea. |
| 44 | .. | 15.7 | 30 | 30 | 3 | 3 | 556 | 491.8 | 491.8 | 11.5 | 19.9 | Strong beam wind and sea. |
| 19 | .. | 10.8 | 25 | 25 | 3 | 3 | 334 | 310 | 310 | 7 2 | 20 6 | Light head wind and sea. |
| .. | .. | .... | .. | .. | .. | .. | .... | ..... | ..... | ... | .... | .... |
| .. | .. | .... | .. | .. | .. | .. | .... | ..... | ..... | .... | .... | Stopped for pilot 11 minutes. |
| .. | .. | | .. | .. | .. | .. | .... | ..... | ..... | .... | .... | .... |
| 216 | .. | 11.9 | 200 | 200 | 21 | 21 | 3.502 | 3,046.5 | 3,046.5 | 13 | 19.21 | |

Sandy Hook light vessel. The originals were worked out by the planimeter. The cards shown are not exactly accurate with the originals, but merely give an insight into the horsepower developed with twin-screw engines. The diameters of the cylinders are high pressure, 38½; first intermediate pressure, 54; second intermediate pressure, 76; and low pressure, 106 inches. The stroke of




the engines is 60 inches. Now, to work out the constant the rule is: area of cylinders multiplied by twice the stroke (in feet) and divided by 33,000 foot pounds; so we have the high pressure running out at $\frac{(38\frac{1}{2})^2 \times .7854 \times 10}{33{,}000} = .3528$. The revolutions per minute of the engines = 88, mean effective pressure = 70; therefore the actual indicated horsepower developed in the high-pressure engine will be $.3528 \times 70 \times 88 = 2{,}173.248$. The decimal points in this case we will ignore for the sake of convenience. The cards shown in the sketch are all worked out, and, as may be seen, the total horsepower for the starboard engine is 9,676, and for the port engine 9,737; the combined indicated horsepower is 19,413. This last figure was used when working out the average I.H.P.

H. J. SPIERS.

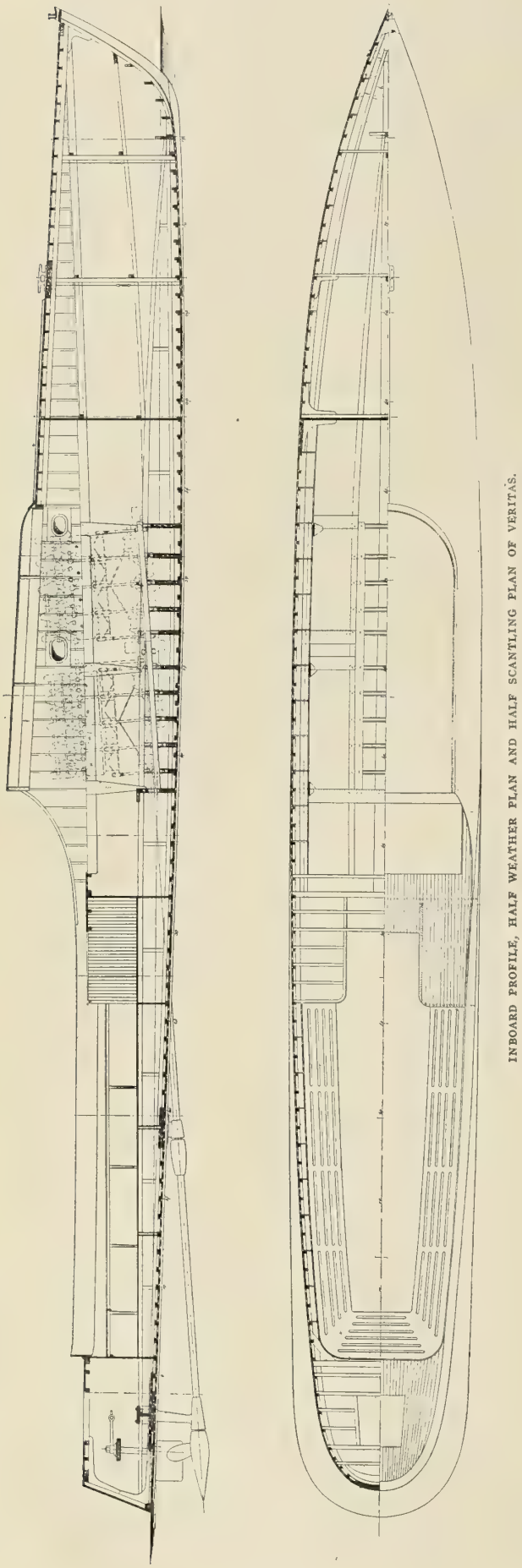
**The United States Civil Service Commission** announces an examination on September 13 and 14 for local and assistant inspectors of hulls to fill vacancies at Philadelphia, Pa., and other places, at $1,800 per annum. This examination is open to all citizens of the United States twenty-five to fifty-five years of age, who comply with the requirements. Applicants should apply to the commission at Washington for forms 1405 and 1087.

An examination on September 13 and 14 is announced for constructing engineer for sewers and water works in the Philippines. The salaries will range from $1,400 to $2,000; the age limit will be eighteen to forty years, and it is required that applicants should have had some experience in either the one line or the other. They should apply to the Civil Service Commission for forms 2 and 375.

## OBITUARY.

Mr. Andrew Fletcher, of the W. & A. Fletcher Company, of Hoboken, has passed away at his country home at Bernardsville. He was the founder of the firm in 1853, the original name being Fletcher, Harrison & Company, which style was changed in 1881 to the present name of the firm. One of the notable products of the original firm, under Mr. Fletcher's management, was the famous Hudson River steamer *Mary Powell*, built in 1861.

Mr. Thomas Jackson Shaw died July 20 at his summer home at Holly Oak, Del. Mr. Shaw was first a pattern maker and then a draftsman in the Dialogue Shipyard, at Camden, N. J. He later became chief draftsman for the Harlan & Hollingsworth Company, of Wilmington, Del., and on his retirement, several months ago, was chief engineer and vice-president of that company.



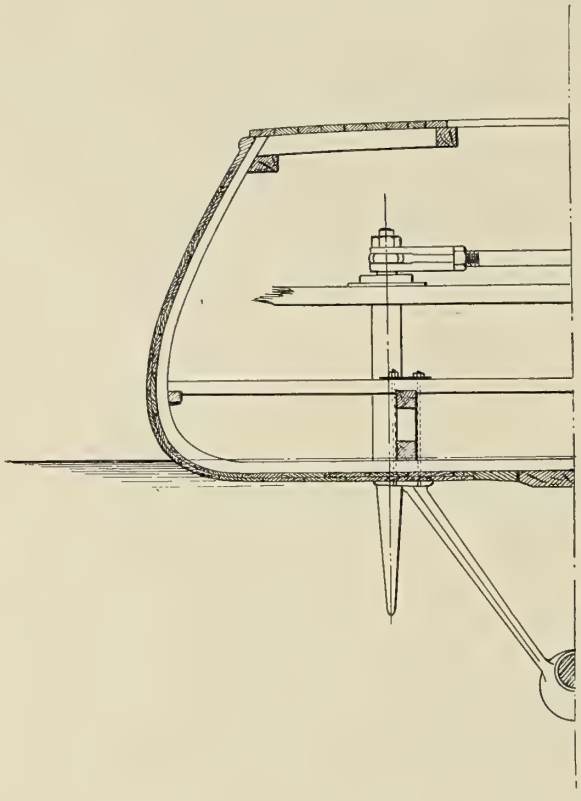
INBOARD PROFILE, HALF WEATHER PLAN AND HALF SCANTLING PLAN OF VERITAS.

## THE NEW AUTO-BOAT VERITAS.

This motor boat is an improvement on the *Onontio,* which was constructed last year from the drawings of the same designer, Mr. Henry J. Gielow, of New York. In general dimensions the new boat has a length over all of 56 feet 8 inches, a length on deck of 55 feet 8 inches, a length on the load water-line of 54 feet 4 inches, an extreme beam of 7 feet and a draft of 3 feet.

As is usual in a craft of this size and description, the *Veritas* is constructed almost entirely of wood, with fastenings of copper and tobin bronze. In a few cases castings have been used of gunmetal and of manganese bronze. The lines are very fine and well calculated to give the high speed for which the boat was designed.

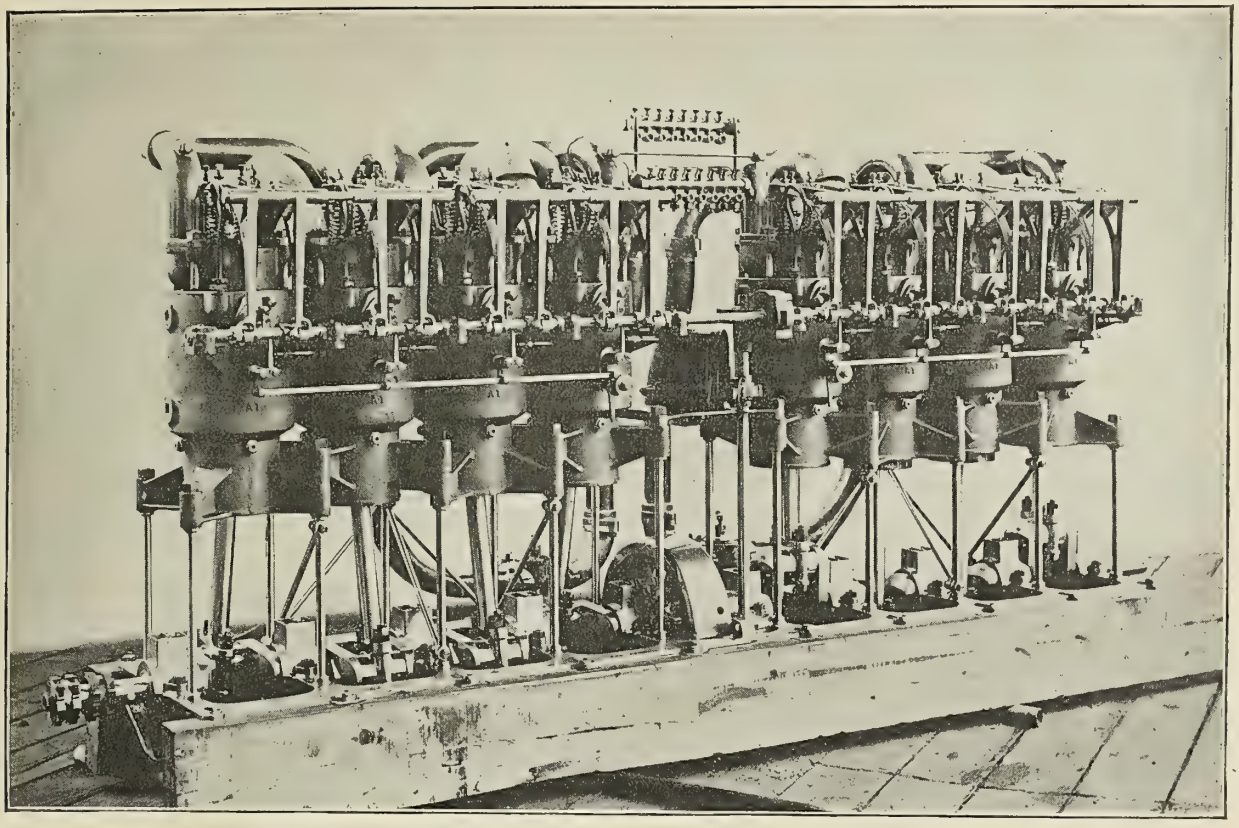
The keel is of white oak made in two lengths, having a width of 4 inches at the forward end and increasing to 10 inches amidships, at which width it is continued to the stern post. The scarf between the two sections of keel has a length of 24 inches, and is fastened with five ¼-inch copper rivets and two brass



SECTION IN WAY OF RUDDER.

screws. The keel is rabbeted to receive side planking. The stem is of chestnut, secured to forward end of keel by means of a 32-inch scarf. The stern post is of white oak, 4 inches deep, and is secured to the after end of the keel and to quarter timbers by means of a hackmatack knee. The frames are of selected white oak, extending in one length from the plank shear to keel, from the stem to frame No. 60 inclusive. In the way of quarter timbers the frames are in two lengths, connected with a hackmatack knee. From frame No. 60 to quarter timbers the frames overlap the keel or center line, reaching a maximum of 16½ inches at frame No. 40. All frames are spaced 8 inches between centers, and measure ⅞ by ⅞-inch at keel and ⅞ by ¾-inch at head. The frames between Nos. 32 and 53 extend up above the plank shear to form coaming and sides of turtleback.

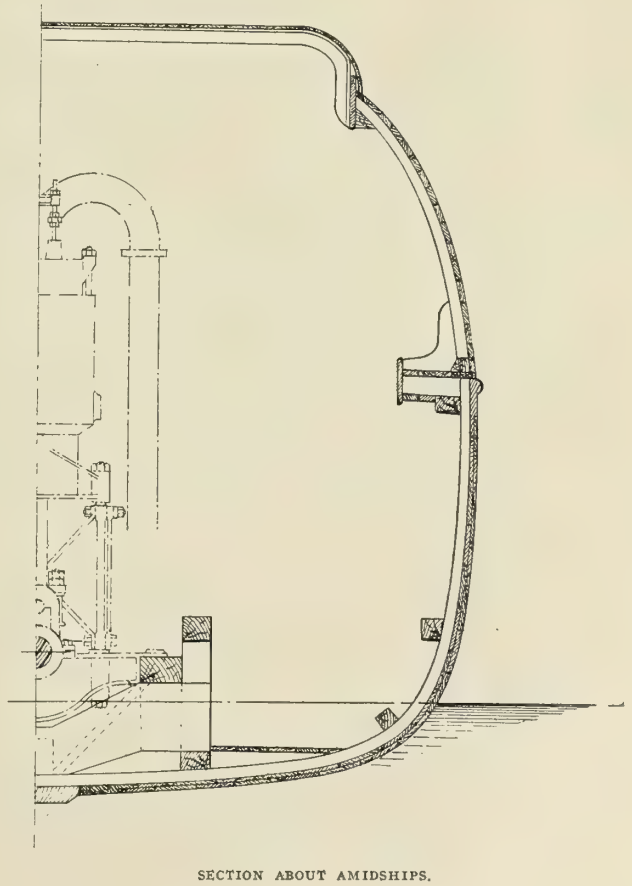
The floors forward of frame No. 59 are of white oak measuring 1¼ by 1½ inches. Side keelsons are fitted of Oregon pine measuring 2½ inches on the siding from frames 15 to 59 inclusive,



EIGHT-CYLINDER FOUR-CYCLE ENGINE OF VERITAS.

and diminishing to 1½ inches at the ends. The top strake measures 2½ inches to mold for ⅗ length amidships, and 1½ inches at ends, while the figures for the bottom strake are 1½ inches and 1 inch respectively. These keelsons are connected by hackmatack floors with cedar braces and stiffeners; also by a number of 2 by 2-inch spruce struts. Engine keelsons, measuring 2½ by 3½ inches, extend from frame 38 to frame 53, and carry the weight of the machinery. The deck beams are of white oak, molded 1¾ inches and siding 1 inch, except that beams at frames Nos. 1 and 4 have 1¾-inch siding and Nos. 6 and 32 2½ inches. All beams are spaced one on each frame and crowned 2 inches amidships, except that those for turtleback follow the lines of the turtleback.

The shear strake is of white oak ⅞-inch in thickness and about 4½ inches wide, the lower edge being rabbeted to receive the double planking. It is worked with a molding 1 5/16 inches in thickness. The bilge strakes are of clear Oregon pine in one length, sided and molded 2 inches for ⅗ length amidships, tapering to 1½ inches at ends. All other planking is in two thicknesses with a width of 4 inches on the sides, increasing to 5 inches on the bottom. The inside thickness is of cedar, 5/16-inch thick, and the outside of mahogany, ⅜-inch thick. These are separated by Union silk, covered with varnish, and are held together with button-headed brass screws. The material was planed both sides to a uniform thickness before being fitted. The plank shear is of mahogany ⅝-inch thick on outside and ½-inch on inside, and 4½ inches wide, fastened to each beam and to edges of shear strakes with brass screws. The deck plank is of white pine ½ by 2½ inches at stern and amidships and ⅜ by 2 inches on turtleback, the seams being laid in white lead. There are three bulkheads, located respectively on frames 6, 32 and 59. All are constructed of white cedar in two diagonal layers each ¼-inch in thickness, with a layer between of Union silk covered with varnish, and all fastened together with copper rivets. There are two hatches, one of which is located in the bulkhead on frame 59, with a clear opening of 15 inches vertically and 18 inches transversely, while the other is in the after deck and measures 20 by 24 inches. The cockpit extends from frame 6 to frame 26 and measures 13 feet 3 inches in length, with after corners rounded, and with a forward extension for the helmsman measuring 2 feet 8 inches long and 2 feet 9 inches wide. The sides of



SECTION ABOUT AMIDSHIPS.

the cockpit are parallel with the sides of the vessel and at a distance of 4½ inches from them. The floor is of ash ⅜-inch thick, the coaming of white oak ⅜ by 9½ inches and projecting 6 inches above plank shear, while a white oak molding is worked along the deck. Along the sides and after end of cockpit are fitted stationary seats 15 inches wide, supported along the inboard edge by eight turned mahogany stanchions.

The engine, designed and built by Mr. James Craig, Jr., of New York, is of the four-cycle type, with eight cylinders arranged in two tandem groups of four cylinders each. The cylinders measure 7¾ inches in diameter, with a stroke of 9 inches, and were designed to give a total of 175 horsepower at 650 revolutions per minute. Maximum speed is obtained with 800 revolutions per minute. The bedplate is a casting of manganese bronze, with vertical members and top and bottom flanges, forming a very rigid girder structure. It is made in halves, one for each group of cylinders. The vertical members consist in each group of ten steel rods ⅞-inch in diameter, passing through projecting lugs forming part of the cylinder castings. The flywheel, which, on account of the high speed of revolution, has been made small and light for the power developed, is situated between the groups of cylinders, and measures 18 inches in diameter, with a face of 5 inches. It serves as a coupling between the two groups, and permits the forward set to be uncoupled when desired. The engine, complete, weighs 3,500 pounds.

The cylinders have the usual encircling water jackets, and the heads form jackets for the valves, which pass through them. The water is carried from the cylinder water jacket to the head by means of a brass pipe, and thence by another pipe to the exhaust pipe. There are two inlet and two exhaust valves, operated by bell-crank levers, in each head. The gear is so arranged that one of the valves is opened slightly in advance of the other. The oil-feed reservoir and the dynamo for ignition purposes are placed between the groups of engines, above the flywheel.

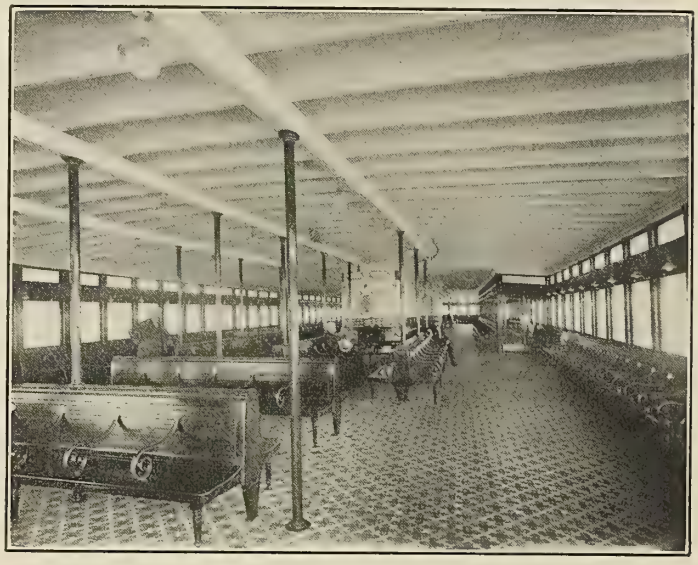
The propeller wheel has a diameter of 30 inches and a pitch of nearly 60 inches, with feathering blades. The reversing gear is of the bevel gear type, and operates by means of a screw and handwheel on the port side.

There are two rudders of manganese bronze operating through rudder ports consisting in each case of a composition casting 3½ inches in length with a 2⅜-inch hole through the center. The upper end of this hole is threaded for a brass pipe of 2¼-inch inside diameter, while the lower end is fitted with a phosphor bronze bushing 3½ inches long and ¼ inch thick, leaving an opening in bushing of 1⅞ inches diameter. The lower end of this composition casting fits into a brass plate fastened to under side of hull. The rudders themselves have each a stock of 1⅞ inches in thickness in way of phosphor bronze bushing, tapering to 1 inch at the upper end. The part below the hull is flattened out and drawn down to ¼ inch in thickness at the lower end, and is worked to sharp edges at forward and after sides. The upper end is tapered and fitted with a tiller yoke, adjustable connecting bar and bearings. The boat is steered by a 20-inch brass steering wheel of the automobile type, with a rack and pinion. This wheel is located in the forward end of cockpit and operates a tiller rope of steel wire 1 inch in circumference through composition sheaves 5 inches in diameter.

The shear strake is finished in varnish thoroughly rubbed down. From the under side of this strake to within 2 inches of the designed load water-line the outside of the hull is painted white, and from this line down she is painted with green copper paint. The turtleback and deck are finished in varnish, as is the case with the under side of the deck and turtle back and the inside of the hull down to a level just below the cockpit floor. From this line down to the keel the floor or bottom of the hull is painted with red lead and oil. The name and port are put on the launch in gilt letters, and a gold strip is run all the way around the hull. The general *ensemble* is a boat of very pleasing appearance. The owner is Mr. Alexander Stein.

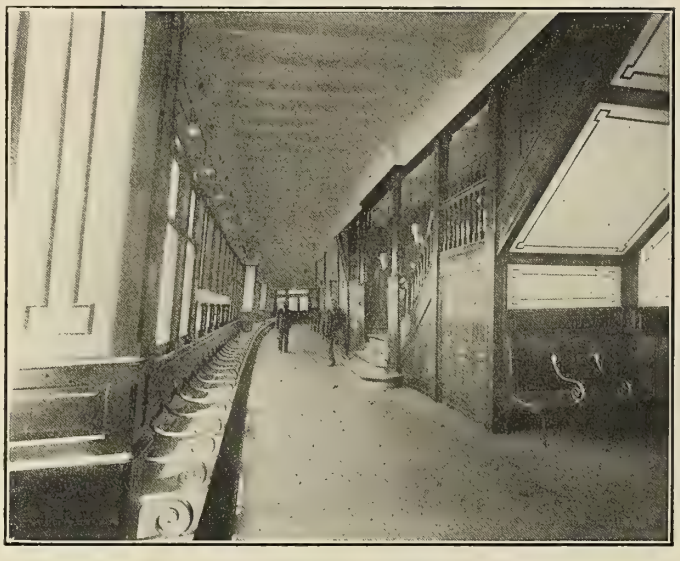
### The New Staten Island Ferryboats.

The ferryboat *Manhattan*, shown in the accompanying photographs, is one of five which the Maryland Steel Company of Sparrow's Point, Md., contracted about one year ago to build for the City of New York, for the Staten Island route. They are the largest and fastest ferryboats yet built for New York



ON THE UPPER DECK.

harbor, and, in a recent trial on the Chesapeake, the *Manhattan* made a speed of over 18½ miles per hour against the tide. The dimensions are 250 feet over all, 66 feet beam over guards, and 19½ feet deep. The hulls are of steel, so sub-divided by bulkheads as to make them practically unsinkable. None of the bulkheads have doors, so that nothing is left to chance in case of



ONE OF THE MAIN STAIRWAYS.

collision, and duplication of appliances has been carried out much more than is usual, guaranteeing immunity against disablement.

The interior finish is mahogany, with composite board panels, the seats being mahogany. The upper saloon is covered with rubber tiling, and the lower saloon with linoleum. An innovation that will be appreciated is the complete separation of the smoking saloon from the other parts of the boat, which is accomplished

THE NEW STATEN ISLAND FERRYBOAT MANHATTAN.

by the location of the stairs. The toilet arrangements are ample, and are of the most modern character. Everything necessary in the way of life-saving appliances is provided, as called for by the latest steamboat inspection rules. The public will undoubtedly be pleased with the very liberal electric lighting installation, there being two large duplicate plants.

The propelling machinery consists of a double compound engine with cylinders 22½ and 50 inches in diameter by 30 inches stroke, driving a propeller at each end of the boat, the shaft being continuous. The boilers are of the Babcock and Wilcox water-tube type, having 340 square feet of grate and 12,500 square feet of heating surface. There are four of them, two in each fire room on either side of the engine compartment. Independent pumps and various auxiliaries are supplied in a most liberal manner. Two complete duplicate sets of signal appliances are installed to insure against breakdown.

IN THE LOWER SALOON.

It is to be regretted that the city is to be denied the immediate use of these fine boats, due to a failure to provide suitable terminal slips. The dilatory tactics resulting in this state of affairs will probably delay the inauguration of the new service for several months. The boats will be found fully described in MARINE ENGINERING for September and October, 1904, and January, 1905, at pages 407, 473 and 35.

## Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, report under date of August 10, 1905, the following percentage of completion of vessels building for the United States Navy:

| | | | | July 1. | Aug. 1. |
|---|---|---|---|---|---|
| **BATTLESHIPS.** | | | | | |
| Virginia | 19 | knots. | Newport News Co | 89.71 | 91.37 |
| Nebraska | 19 | " | Moran Brothers Co | 75. | 77. |
| Georgia | 19 | " | Bath Iron Works | 82.66 | 85. |
| New Jersey | 19 | " | Fore River Shipbuilding Co | 86.2 | 87.7 |
| Rhode Island | 19 | " | Fore River Shipbuilding Co | 88.8 | 92.1 |
| Connecticut | 18 | " | Navy Yard, New York, N. Y. | 80.74 | 83.67 |
| Louisiana | 18 | " | Newport News Co | 80.79 | 82.81 |
| Vermont | 18 | " | Fore River Shipbuilding Co | 53.6 | 57.1 |
| Kansas | 18 | " | New York Shipbuilding Co | 55.1 | 57.8 |
| Minnesota | 18 | " | Newport News Co | 68. | 69.9 |
| Mississippi | 17 | " | Wm. Cramp and Sons | 31.28 | 34.48 |
| Idaho | 17 | " | Wm. Cramp and Sons | 29.57 | 33.22 |
| New Hampshire | 18 | " | New York Shipbuilding Co | 11.2 | 15.2 |
| **ARMORED CRUISERS.** | | | | | |
| California | 22 | knots. | Union Iron Works | 78.3 | 80.4 |
| South Dakota | 22 | " | Union Iron Works | 76.1 | 78.9 |
| Tennessee | 22 | " | William Cramp and Sons | 79.4 | 82.02 |
| Washington | 22 | " | New York Shipbuilding Co | 79.1 | 82.03 |
| North Carolina | 22 | " | Newport News Co | 9.14 | 12.2 |
| Montana | 22 | " | Newport News Co | 7.98 | 10.81 |
| **SEMI-ARMORED CRUISERS.** | | | | | |
| St. Louis | 22 | knots. | Neafie and Levy Co | 67.4 | 71.4 |
| Milwaukee | 22 | " | Union Iron Works | 75.2 | 79. |
| Charleston | 22 | " | Newport News Co | 97. | 99. |
| **GUNBOAT.** | | | | | |
| Paducah | 12 | knots. | Gas Engine and Power Co | 88.9 | 92.4 |
| **TRAINING SHIPS.** | | | | | |
| Cumberland | Sails | ... | Navy Yard, Boston | 95. | 95. |
| Intrepid | " | .... | Navy Yard, Mare Island | 97.5 | 97.5 |
| **TORPEDO BOATS.** | | | | | |
| Goldsborough | 30 | knots. | Wolff and Zwicker | 99. | 99. |
| O'Brien | 26 | " | Lewis Nixon | 99. | 99. |
| **SUBMARINE TORPEDO BOATS.** | | | | | |
| Submarine No. 9 | | | Fore River Shipbuilding Co. | 0. | 12.6 |
| " " 10 | | | Fore River Shipbuilding Co | 0. | 11.5 |
| " " 11 | | | Fore River Shipbuilding Co | 0. | 11.5 |
| " " 12 | | | Fore River Shipbuilding Co | 0. | 11.5 |

## SHOP ECONOMICS.

BY THEODORE LUCAS.

For all manufacturing in general, as well as for the production of ships and their machinery in particular, the equation has to hold good:

$$\text{Cost} + \text{profit} = \text{selling price.}$$

The selling price is the only factor in this equation that is subject to competition. It is therefore a quantity that can be influenced very little by a single concern, but which will remain more or less at a stationary figure, until changes in the material or labor cost affect all competitors in about the same way.

The two other factors are dependent entirely upon the builder in their interrelation, such that a relatively small production cost is accompanied by a relatively large profit, which of course is the desired result of all manufacturing activity.

Dividing the production cost into three subdivisions, namely:

General expense;

Material cost;

Labor and tool cost;

it is apparent that each of these subdivisions should be as small as possible to realize the minimum of total production cost. The great desideratum for lowest cost is therefore to make sure that each and every one of the subdivisions is the lowest possible not only in its totality, but also in each and every one of the component detail parts that comprise the whole subdivision, down to the smallest unit and the minutest operation of every individual worker or machine.

This certainty of efficient individual unit operation should then be gained with the minimum of supervision in an automatic manner, that through clearly prescribed channels will accumulate the desired data accurately, quickly, and cheaply.

The ablest mechanical minds have bent their energies—in the last 10 to 15 years with rapidly increasing intensity—upon the task of devising methods and systems by which a more or less automatic collection of the vital data can lead to the certainty of lowest production cost of even the minutest individual unit operation.

What is evidently needed to accomplish this purpose is a comprehensive internal system of cost accounting that in full completeness is at the same time so lucid and simple that each and every unit operation can be singled out for comparison with the best record or standard, to ascertain if it has been accomplished at lowest cost or not.

To enable all clerks, draftsmen, foremen, and workmen to file or record unit operations, in clear, accurate, and lucid manner, it is necessary to predetermine a full classification of all operations in form of data blanks or cards, that clearly state what should be recorded upon them.

A classification with subdivisions that probably will cover all work performed in shipyards has been used for weight estimates and been advocated for wider application by the writer as follows:

A. Steel in hull.
- I. Longitudinal and transverse framing and plating.
- II. Decks.
- III. Castings and forgings.
- IV. Bulkheads.
- V. Miscellaneous steel work.

B. Cement, paint, tiling.

C. Carpenter work.

D. Joiner work.

E. Outfit and equipment.
- I. Fittings for handling whole ship.
- II. " " supply and discharge.
- III. " " interior communication.
- IV. " " safety and protection.
- V. " " ornamentation.

F. Boiler-room weights.

G. Engine-room weights.

H. Shaft-alley weights.

I. Coal.

J. Fresh water, stores, provisions.

K. Crew, passengers, effects.

L. Cargo.

As seen the classification takes as the basis the complete weight distribution of a ship and distributes even the trial-trip expenses to the items J, K, and L.

The leading principle throughout the classification is to charge every possible expenditure to specific contracts and jobs, thus disposing of them when the contract is completed.

As few items as possible should be charged to general expense. This latter should be confined primarily to salaries of the general officers of the concern, to selling, advertising, and traveling expenses incurred not directly in connection with special contracts.

In regard to items like taxes, insurance, power, heating, lighting, wages for engineer, firemen, watchmen, general laborers, etc., it seems—at least to the writer—that it would be possible to allot these charges to special operations and contracts. For example, taxes are levied on real estate, which supports various buildings, in which a number of men work a certain number of hours. The total number of men hours, say 3,000,000 per year, can be placed in relation to a tax expenditure of say $3,000; resulting in a rate of 0.1 cent per man hour. Such figures can similarly be approximated for fire and accident insurance, taking care to charge certain departments perhaps with a higher rate than others, as their greater risk or larger use of buildings or appliances make such differences desirable.

Expense for power can readily be distributed to different tools, forming one of the charges in the determination of the total tool cost.

Heating and lighting can be placed in relation to men hours, taking care to proportion this part of steam expenditure to that for power, so that at the end of the year the total charges are equal to the sum total of all direct recorded expenses for coal, oil, supplies, wages of engineers and firemen.

In a short time it will be possible to establish average rates, by which a fair distribution of the expenditures to productive detail operations of men or tools, or to the care of materials, can be secured.

The item of material cost is readily determined by a centralized store-room system with receiving and shipping branches under the supervision of a purchasing agent or clerk. The principle rigidly adhered to is that no materials of any kind are moved or given out without a bill of material, a requisition, or receipt. These may be conveniently executed in card form, stating distinctly the contract job or special application of such material in rough or finished state, of auxiliary machinery, or even of completed machines, engines, boilers, turrets, masts, etc. In the latter cases the requisition or receipt takes the form of a bill of material, specifying clearly all parts and attachments. Such a clear record should and does do away with a great deal of carelessness or dishonesty that frequently takes place in large establishments with regard to the material question. That nocturnal small boats carry sometimes loads of brass fittings or lead and copper pipe from partly completed ships, or that tons of spoiled material are sunk into the river or hidden in dark corners are occurrences that an intelligent store-room system with clearly defined responsibility of foremen and workmen can readily avoid.

For the keeping of such stores' accounts the simplest form of ledger with credit and debit columns, in either book or card form, can efficiently perform the duty of placing responsibility.

Tool and fixture rooms, which for convenience are located in the different departments, can readily be treated as adjuncts or special branches of the general store-room system, with the same method of card or check control and full record of receipts and deliveries.

The most important item of internal shop economics is that of the labor cost, and conveniently connected thereto that of the tool cost. This is probably the one that in most cases of manufacturing activity—whether in regard to hulls, boilers, engines, auxiliaries, or other products—contributes the largest percentage of the

TABLE A.

400′ × 52′ × 30′ STEEL IN HULL.

| | | Weight. | | Material. | General Expense. | Correspondence, Clerical Work. | Drafting, Ordering, Mold Loft. | Freight, Handling, Setting Up. | Making Molds, Laying or Shearing, Planing. | | Punch, Drill, Countersink. | | Bar Furnacing. | | Plate Flanging, Rolling. | | Riveting, Bolting. | | Caulking, Chipping. | | Painting, Cement. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Tons. | Pounds. | $ | $ | $ | $ | $ | Sq. Ft. | $ | No | $ | Feet. | $ | Sq. Ft. | $ | No. | $ | Feet. | $ | Sq. Ft. | $ |
| 1 | I.—Long. Transv. Fram. Plate. | | | | | | | | | | | | | | | | | | | | | |
| 2 | Keel, Longitudinals | 148.0 | 334,500 | 5,686.50 | 1,337.50 | 664.30 | 537 70 | 1,012.40 | 19,730 | 169.40 | 48 120 | 552.10 | 5,210 | 379.30 | 3.370 | 478.30 | 18 600 | 364.70 | 3,710 | 296.30 | 38,400 | 114 10 |
| 3 | Shell Plating | 592 0 | 1,327,800 | 22,572.60 | 4,713.40 | 782 40 | 1,114.90 | 4,117.40 | 126,380 | 693.20 | 379,800 | 3,896.80 | .... | .... | 50,370 | 2,872.90 | 159,800 | 4,764.20 | 37,600 | 2,474.90 | 233,000 | 897 40 |
| 4 | Inner Bottom | 135.0 | 303,700 | 5,162.90 | 1,210.70 | 602.30 | 899.70 | 917.90 | 30,340 | 273.10 | 83,360 | 817.00 | .... | ..... | 3,340 | 382.80 | 23 200 | 679.40 | 8 860 | 627.40 | 141,200 | 517.70 |
| 5 | Frames, Reverse Frames | 237.0 | 533,100 | 9,062.70 | 2,131.00 | 1,014.20 | 1,314 70 | 2,697.40 | 32,130 | 299 40 | 4 320 | 186.80 | 153,410 | 1,765.50 | 68.37 | 3,979.40 | 33,200 | 840.70 | 3 620 | 216.20 | 44 360 | 238 60 |
| 6 | Floors, Webs, Brackets | 179.0 | 402,800 | 6,847.60 | 1,602.80 | 814.30 | 734.60 | 1,814.70 | 31,430 | 187.60 | 34,170 | 736.70 | 79,340 | 1,107.40 | .... | 8.470 | 21,420 | 711.40 | 1,230 | 161.30 | 34,270 | 111.90 |
| 7 | II.—Decks. | | | | | | | | | | | | | | | | | | | | | |
| 8 | Beams, Brackets | 193.0 | 432,100 | 7,345.70 | 1,731.40 | 796.40 | 627 80 | 1,364.90 | 8,100 | 64 10 | 5 260 | 122.30 | 38,350 | 374.10 | 9,950 | 437.10 | 9 320 | 197.30 | 640 | 27 30 | 26,490 | 84 20 |
| 9 | Deck Plating | 331.0 | 741,600 | 12,607.20 | 2,963 20 | 973 40 | 813 40 | 2,127.10 | 49,320 | 391.50 | 29 470 | 759.40 | 115,710 | 1,516 60 | .... | ..... | 43 260 | 1,184.90 | 23 270 | 1,474.10 | 46,710 | 247.80 |
| 10 | Stringer Bars | 23.0 | 51,500 | 875 50 | 207.20 | 97.30 | 78.10 | 194 30 | 7,130 | 57 30 | 230 | 3.70 | 27,340 | 189 80 | 6,010 | 291.70 | 9,360 | 248 10 | 9,420 | 710 70 | 3 730 | 46.10 |
| 11 | Stanchions, Stringers | 39.0 | 87,800 | 1,492.60 | 336.90 | 158.20 | 97.20 | 311.40 | 18,370 | 179 10 | 340 | 8.40 | 36,710 | 378.20 | 5,480 | 302.40 | 8,740 | 175.70 | 470 | 21.30 | 15 320 | 48.20 |
| 12 | III.—Castings, Forgings. | | | | | | | | | | | | | | | | | | | | | |
| 13 | Stem, Stern Post | 17.0 | 38,100 | 1,847 70 | 139 00 | 73 40 | 172.60 | 119 40 | 113 | 3 20 | 173 | 4.30 | 7,30 | 11 70 | .... | ..... | 518 | 20.10 | 126 | 10.10 | 310 | 1 20 |
| 14 | Rudder Complete | 13.0 | 29,200 | 1,496.40 | 107.30 | 54.20 | 146.70 | 97.80 | 107 | 2.60 | 78 | 3.80 | 6,70 | 9 40 | .... | ..... | 620 | 21.30 | 48 | 8.60 | 510 | 1.80 |
| 15 | Rivet Heads | 77.0 | 172,800 | 2,939.60 | ..... | ..... | ..... | 428.60 | ..... | ..... | .... | ..... | ..... | ..... | 200 | 4.70 | ... | ..... | .... | ..... | ..... | ..... |
| 16 | IV.—Bulkheads. | | | | | | | | | | | | | | | | | | | | | |
| 17 | Transv., Long. Bulkheads | 97.0 | 217,400 | 3,695.80 | 853.10 | 474.00 | 714 90 | 712.80 | 26,660 | 173 20 | 20,120 | 334.40 | 70,370 | 963.40 | 4,670 | 282.30 | 20,760 | 478 40 | 4,850 | 397.40 | 43,020 | 131.70 |
| 18 | Casings, Deck Houses | 23.0 | 51,500 | 875.50 | 199 70 | 103.40 | 235.70 | 234.70 | 7,830 | 61.10 | 2,830 | 63 90 | 23,420 | 317.50 | 1,940 | 231.20 | 5,430 | 121.20 | 1,970 | 249.80 | 11,040 | 35 20 |
| 19 | V.—Miscellaneous Steel. | | | | | | | | | | | | | | | | | | | | | |
| 20 | Doublings, Foundation | 17.0 | 38,100 | 647.70 | 162 00 | 78 40 | ..... | 137.40 | 5,390 | 67.90 | 1,930 | 51.20 | 20,240 | 296 30 | 570 | 126.30 | 1,830 | 191.70 | 5 340 | 137 10 | 940 | 141.90 | 8 920 | 26.90 |
| | | | | 83 154.00 | 17,685.20 | 6,686.20 | 7,704 40 | 16,283.20 | | 4,718.60 | | 12,175.80 | | 5,975.20 | | 7,110.30 | | 9,707.00 | | 6,817.30 | | 2,402.80 |
| | $83,032.70 = Tons, 2,121.0 | | | | | | | | | 2,612.70 | | | | | | | | | | | | |

total cost. It is for this reason that the greatest scrutiny of its amounts should be exercised, so that the lowest possible cost can with certainty be realized in all individual or unit operations. For such close investigation it is highly desirable, and perhaps imperatively necessary, to bring the expenditure of hours and money into a direct relation to accomplished results. These latter should be expressed in such simple and clearly defined form as to allow a ready comparison with similar operations. For example, in hull or boiler work there may be a relation established between cost and lineal feet flanged, planed, sheared, calked, rolled, bent, straightened, or square feet laid off, or holes of a certain size punched, drilled, countersunk, reamed, riveted, expanded, etc. Or for machine work a relation may be established between cost and square inches planed, turned, milled, slotted, shaped, ground, or a number of holes of a certain size drilled, tapped, studded, countersunk, etc. With such data on hand, an intelligent judgment and comparison of the efficiency in the execution of the work can be gained, such as no general charge system probably can realize.

Modern manufacturing methods have long realized that work for the shops has to be laid out and prepared for execution, and it is probably beyond doubt established that the cost of production is small in direct proportion as the layout is complete.

It is for this reason that drafting is carried out more and more completely, even the smallest items being fully detailed and determined. The drafting room is the place in which to prepare not only bills of materials but also bills of operation that state in tabular form all the operations on individual pieces. Taking for example a steam cylinder, there may be determined the square inches of boring, facing, planing, and the number of holes drilled, tapped, studded, as well as the fitting of stuffing boxes, flanges, relief, drain and bye-pass valves, etc. From such a total bill containing space for filling in the hours and corresponding money expenditure after the work is done, it is readily possible to make out job or work orders, specifying in the form of an order only one individual operation out of the total on the bill.

The accompanying general table or bill, A, deals with hull work, but is equally applicable to boiler and sheet-iron work. It was prepared for estimating, and therefore contains only quantities and cost, as the vital characteristics. The wide possibilities of a well-developed unit system are shown therein clearly, as for a new estimate the quantities are even in the earliest conception of the design readily available, and from previous work records also accurate knowledge of their cost, thus leading quickly and with high accuracy to complete total cost values. With great celerity it is possible to allow for fluctuations in the price of raw material—sometimes perhaps only for a few special shapes—or in the cost of labor in all or only some departments.

For cost recording work the tables may with advantage be much larger and more complete, recording hours of labor besides quantities and cost. Separate tables may be executed for carpenter and joiner work, equipment, machinery, and other parts of the work.

A form of job or work order is shown in Table B, giving the general data on the front, while the time stamps and inspection data are to be recorded on the back. The cards are to be printed blanks and the items in the second column of the front are filled in by the estimating draftsman with exception of date, name, check number, tool, and tool time, which are supplied in the shop; and the items on the material which are supplied by the store room. The rotation of the card would be: from the estimating office to the store room, thence with the article to the shop, thence back to the store room with the completed article, and back to the recording office.

By preparing a copy of the total bill as shop order for the foreman, and all the job orders for the workmen beforehand in the estimating office, the routine in the shop would not differ materially from the usual one, the foreman giving out the cards with the work and having the time stamped on at beginning and end of operation.

Table B.

| | Front of Work Order. | | |
|---|---|---|---|
| 1 | Date, | June 13, 1905 | |
| 2 | Name, | J. O. K. | |
| 3 | Check No. | 1,076. | |
| 4 | Hull or Engine | Contract, 407. | |
| 5 | Job No., | $\frac{17 \times 26\frac{1}{2} \times 40}{24}$ | |
| 6 | Drawing No., | 7,941. | |
| 7 | Pattern No., | | |
| 8 | Part, | Piston Rods. | |
| 9 | Size, | $4\frac{3}{4}'' \times 6' - 5\frac{1}{2}''$ | |
| 10 | No. Pieces. | 3. | |
| 11 | Material, | Nickel Steel. | |
| 12 | M terial Good. | 2 Pieces. | |
| 13 | Material Defective. | 1 Piece. | $\frac{1}{4}''$ Short. |
| 14 | Weight, Rough, inv., | 1,725½ lbs. | |
| 15 | Weight, finished, | 1,573 " | |
| 16 | Tool No. | 58 | |
| 17 | Operation, | Turning. | |
| 18 | Rough, | 1,155 sq. ins. × 3 = | 3,465 sq. ins |
| 19 | Finished, | 795 " " × 3 = | 2,385 " " |
| 20 | Contract | Piece. | |
| 21 | Rate, | $1.50. | |
| 22 | Premium, | | |
| 23 | Price, | $4.50. | |
| 24 | Time Limit, | 18 Hours. | |
| 25 | Time of Tool, | 12½ Hours. | |
| 26 | Rate of Tool, 58, | $0.20. | |
| 27 | Tool Cost, | $2 50. | |
| 28 | | | |
| 29 | | | |

| Back of Work Order. | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | Inspector. | S. F. P. |
| Afternoon. | | Out. | | | 5 03 | | | | | | | Date, | June 18 '05. |
| | | | | | | | 3.37 | | | | | Time from | 9.18 |
| | | | | | | | | | | | | To | 9.45 |
| | | | | | | | | | | | | Good, | 1 Piece. |
| | | In. | | | 12.26 | | 12.29 | | | | | Defective, | 2 Pieces. Dia. $4\frac{3}{4}''$ sc. |
| | | | | | | | | | | | | Spoiled, | |
| Forenoon. | | Out. | | | 12.04 | | 12.02 | | | | | | |
| | | | | 11.04 | | | | | | | | | |
| | | In. | | | | 7.24 | | | | | | | |
| June, 1905. | Monday, | | | | | | | | | | | | |
| | Tuesday, | | | | | | | | | | | | |
| | Wednesday, | | | | | | | | | | | | |
| | Thursday, | | | | | | | | | | | | |
| | Friday, | | | | | | | | | | | | |
| | Saturday, | | | | | | | | | | | | |
| Date, | | | | | | | | | | | | | |
| | | | | | | 13 | | | | | | | |
| | | | | | | 14 | | | | | | | |

With all work determined beforehand, the fullest distribution to the tools can be made in such manner that work of the same nature, like punching, shearing, drilling, turning, boring, etc., may be grouped together and thus keep one man on quite a run of work of the same nature, leading to fuller and more regular employment of the tool and greater efficiency of the man.

To secure quick and handy distinction and filing the job orders for the different departments may be printed on cards of different colors and may be notched for main subdivisions at the top and additionally at the side for further detail subdivision.

Thus it may be possible to employ for:

A white cards. B pink cards.

C and D blue cards.

E yellow cards. F green cards.

G and H red cards.

A would have from 1 to 5 top notches.

E would have from 1 to 5 top notches.

F would have from 1 to 2 top notches.

G and H would have from 1 to 4 top notches.

Systems of recording individual operations have wide possibilities. They record unmistakably the capacity of the workmen and tools, a fact that will be quickly realized by the men, spurring them on to more faithful discharge of their duties and quickly singling out the good men and efficient tools in an impartial manner.

The job tickets can be used directly for piece work and previous complete records of such individual operations can in the hands of a competent and judicious man lead to rate fixing that is fair to both employer and employee. Even for jobs of a new or complicated nature it is possible to fix a fair price by building up the total cost out of single operations, of which prices are on hand. Due allowance can be made for setting the work in tools, handling by crane, etc., leading for the totals to results that should prove just to the workman without that excess of earnings that by subsequent reduction produces much of the friction often connected with the practice of piece-work systems.

It may not be possible to always determine all of the operations beforehand, as defects or variations in complicated castings may demand changes in the operations, different sizes or spacing of studs or bolts, less finishing on certain surfaces than intended, etc. The job-ticket system, however, is so flexible that the foreman on his own or higher authority could cancel or alter certain tickets and items in the bill of totals and substitute or add others.

The tool cost is an item that in establishments employing many high-priced tools may prove of considerable value. The tool cost as distributed to the different jobs or operations may be considered as composed of an interest charge, a depreciation charge, a power and attendance charge, and a special tool, jig, and fixture charge. These different items can be figured to a rate per hour that allows immediate application on the same job ticket upon which the man running the machine records his activity.

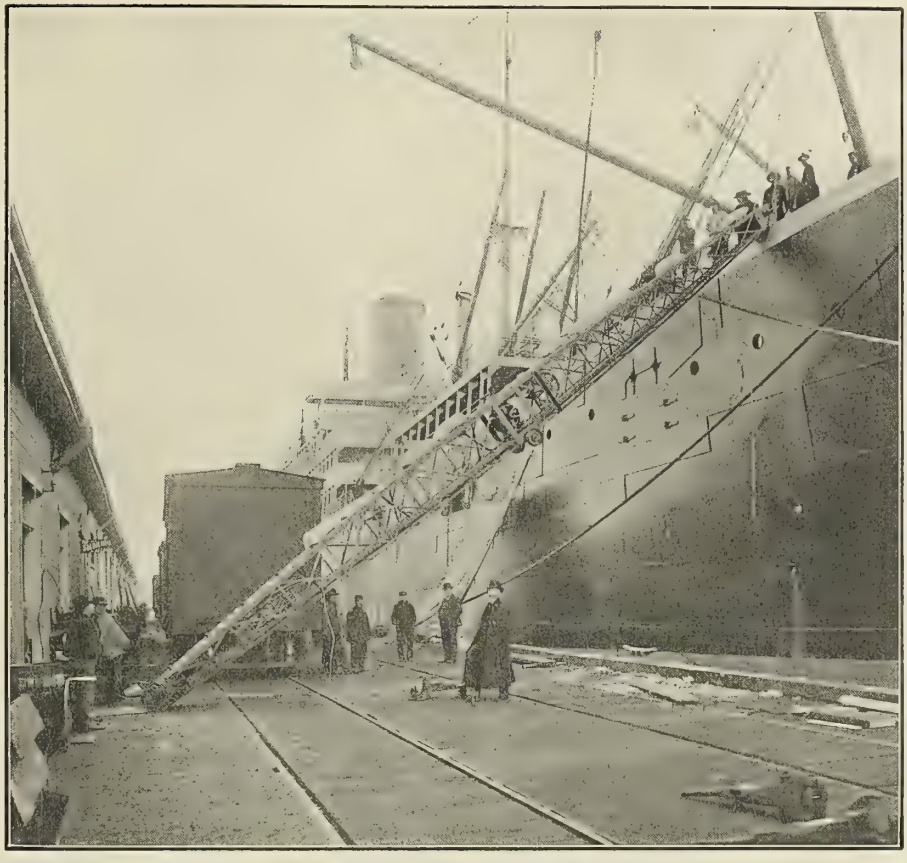
Assuming the full usefulness of the machine as extending say over a period of ten years, at a certain mean number of hours of activity, the rate for interest and depreciation is directly available. The power charge is not so readily derived, but by having the yearly cost of the power and attendance and the total number of horsepower developed it is possible with the help of a few dynamometer experiments on different classes of machines to allot fair values of cost of power consumption to each machine. Where electrical driving of the machine tools is employed, the power consumption is, of course, much more readily determined from the readings of the measuring instruments.

The tool, jig, and fixture charge is generally a fluctuating one, as part of the work may demand a number of fixtures, while part may require none at all. Where special jigs and fixtures are made for one particular job it seems best to charge their cost entirely to the work, as often their application decreases the required number of men hours and thus forms a substitute for the decrease in labor cost. Where the fixtures are of such nature as to be readily available for other work a charge of a percentage of their cost may often seem the fairest.

## A New Electrically Operated Ship Loading Device.

BY FRANK C. PERKINS.

In American as well as European harbors the great steamship lines are taking advantage of every labor-saving device available which will insure a more economical and rapid method of loading and unloading the great vessels lying at the wharves. The accompanying illustration shows a new electrically-operated registering conveyor capable of passing 4,000 sacks per hour to the deck of a vessel, automatically counting and registering them without error. The conveyor is of steel construction, 50 feet long, and is shown loading freight on the mammoth twin-screw steamer *Minnesota*. It was installed for the Griffith and Sprague Stevedoring Company by the Spence Registering Conveyor Company, of St. Paul.



THE LOADING DEVICE AT WORK ON STEAMSHIP MINNESOTA.

An electric motor of 5 horsepower is utilized for driving the traveling apron, which runs on steel anti-friction roller bearings, the rollers being set two inches apart on both sides of the conveyor, thus reducing the friction to a minimum. On this apparatus slats are used instead of a belt, so that cased goods, barrels, bales, or other kinds of package freight can be handled without difficulty. By means of a special controller the speed of the machine may be varied from 75 to 175 feet per minute according to the kind of material being handled.

In addition to the 50-foot steel conveyor shown in the illustration, two or more trailers may be utilized by means of sprocket chain and gearing. On the wharf or in-shore end a 35-foot trailer is used for conveying the freight from the inside of the warehouse, while another 35-foot conveyor of the same type carries the sacks or other freight across the deck of the steamer, delivering them to gravitation chutes, which are provided with a brake governing with the greatest ease the speed of descent to the hold of the vessel. This combination, including the gravitation chute, gives an equivalent of a single conveyor 120 feet in length. The gravitation registering chutes absolutely dispense with the services of tallymen, and are operated without motors of any type. The electrically-operated registering conveyor has a counter which works automatically, while the electric power is reversible, so that by simply operating a switch the freight may be either carried to the ship from the dock, or *vice versa*, as desired. A number of these electrically-operated labor-saving devices are in operation at the New York docks of the Old Dominion Steamship Company and the Northern Pacific Railway Company. An electric switch is provided at the upper end of the conveyor to stop the machine instantly if found necessary, or to reverse the direction of operation. There are spring-operated press-buttons provided which are depressed with the slightest pressure, thus engaging the arm of the counter and insuring a reliable tally.

## New Barge for the General Navigation Company of Lake Geneva.

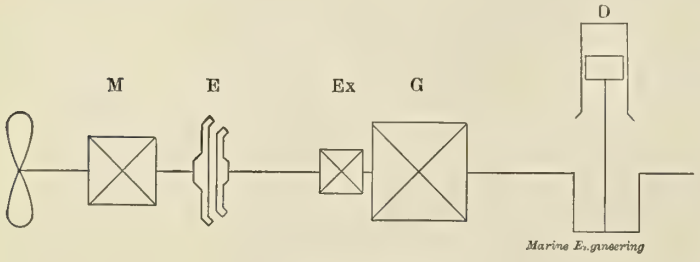
BY L. RAMAKERS.

In view of the constant increase in water traffic, the General Navigation Company, of Lake Leman (Lake Geneva), Switzerland, has had constructed a new boat for freight service on that lake. The power required for propelling the barge, as well as for operating the winches, will be furnished by a petroleum motor of the Diesel pattern from the Sulzer works. This motor will operate in only one direction and at a constant speed. It is, therefore, necessary to make use of a special system of control for making landings, increasing or decreasing the speed of the boat, running backward, etc. After considerable study, it was decided to adopt as an intermediate piece of mechanism, electrical machinery, which offers a flexibility and elasticity impossible to be obtained with mechanical devices, the increase in weight which results having no great importance on a barge.

The arrangement adopted is as follows:

The Diesel motor, *D*, operates directly the generator, *G*, with an exciter, *Ex*, upon the same shaft. At the end of the shaft of this generator group is placed one of the members of a magnetic clutch, *E*, permitting the first group to be coupled to the second, which is composed of an electric motor, *M*, operating the

propeller. At the forward extremity of this group is placed the second member of the magnetic brake. In order to start the boat, the Diesel motor is brought up to its normal speed, but the coupling, *E*, being loosened, the screw propeller is not operated. The exciter furnishes current for the field coils of both the generator and the motor. By means of a special starting device, the dynamo is first excited and the current of this acts in its turn to operate the motor. The screw being thus put into action, the boat moves on. When the generator and motor groups are running at the same speed, all that is necessary is to shove over to a stop the lever of the starting device, in order that the magnetic brake, under excitation from the generator, may be put in operation. At this




SCHEME OF APPARATUS.

moment the motor, *M*, is disconnected, and it is the petroleum engine which directly operates the screw, the two groups being rigidly joined together.

In order to move astern, it is necessary to replace the starting device lever to zero. The magnetic brake is then disconnected and the lever moved to the rear, when the current in the motor is reversed and turns the shaft in the other direction, operating the screw for rearward motion of the boat.

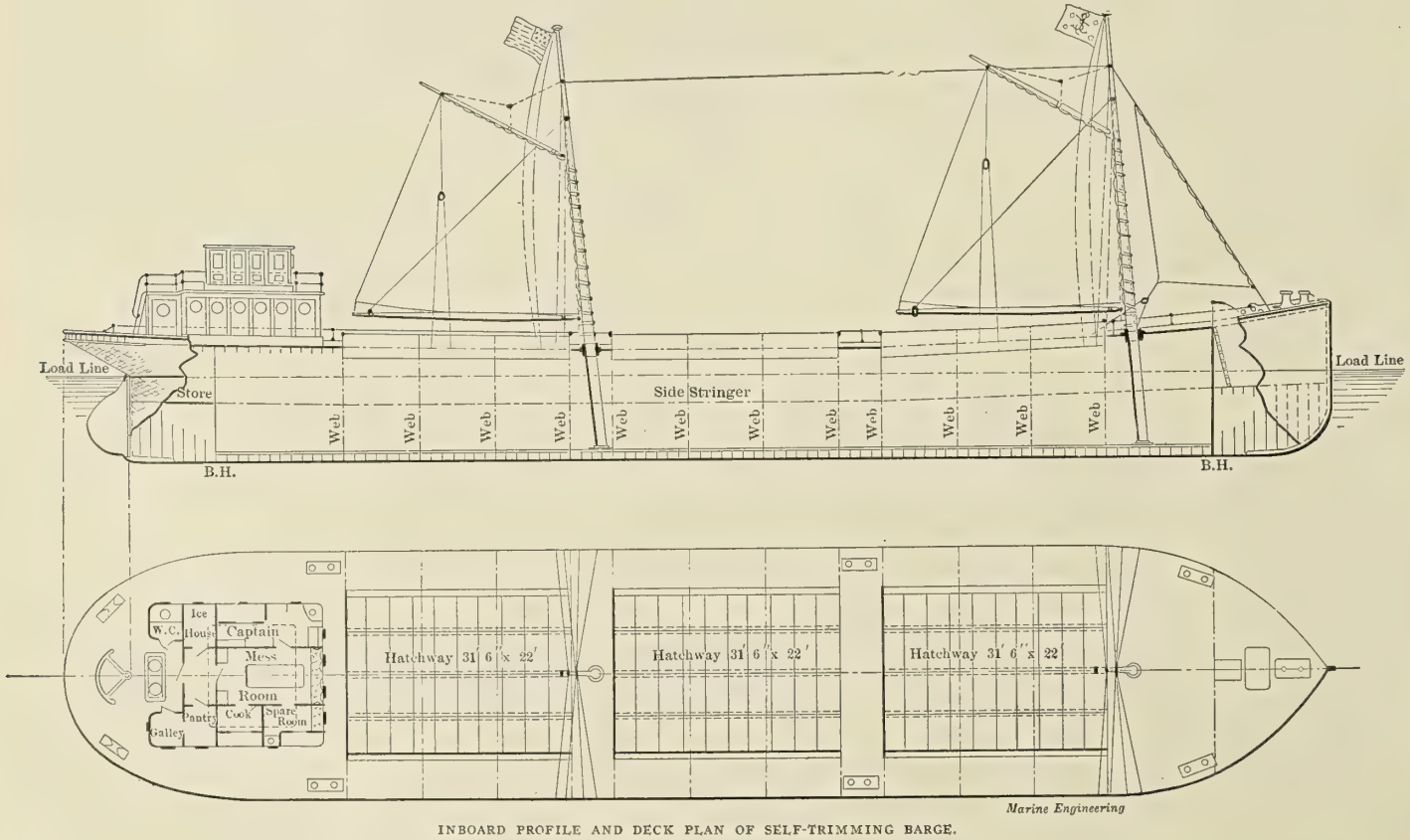
The Diesel motor gives from 40 to 45 effective horsepower at 260 revolutions per minute. The generator, which is of the direct-current type, has been designed to give voltages varying from zero to 110 volts, and furnish a normal of 20 horsepower, being able, however, to accept a momentary load of 40 horsepower. The motor may be operated from a zero speed to a maximum in either direction. It is, therefore, possible to obtain in making landings a satisfactory speed without jar or shock, while the starting device, as we have already said, acts not only upon the main circuit but also upon the excitation of the generator. For the other part of the power, a special electric motor has been designed to operate the capstan placed upon the boat, and a switch placed upon the switchboard near the machine permits the sending of the current from the generator into either the motor operating the screw or that for the capstan. The latter is composed of a roller with two drums operated by means of an endless chain, the drums being able to operate separately or together according to the weight of the load which is to be raised. The motor operating the capstan is capable of furnishing a normal of 8.8 horsepower. The speed of the motor is 1,250 revolutions per minute, corresponding with a hoisting speed of 32 meters (105 feet) per minute, with a load of 500 kilograms (1,102 pounds). When necessary, the speed may be increased to 2,500 revolutions per minute, corresponding with a hoisting speed of 64 meters (210 feet), with a load of 250 kilograms (551 pounds). The starting device is placed beside the capstan, and carries a brake acting upon the shaft of the motor and permitting the descent of the load to be carefully regulated. This starting device is similar to that of the motor operating the screw propeller; that is to say, it acts by means of a current from the generator, and permits a variation of speed from zero to a maximum in either direction.

All the electric connections between the separate pieces of apparatus and machines are carried in cables of lead, which are proof against moisture. The complete electric equipment has been installed by the Company of Electric and Mechanical Industry of Geneva.

---

### 1,000-Ton Self-Trimming Barge.

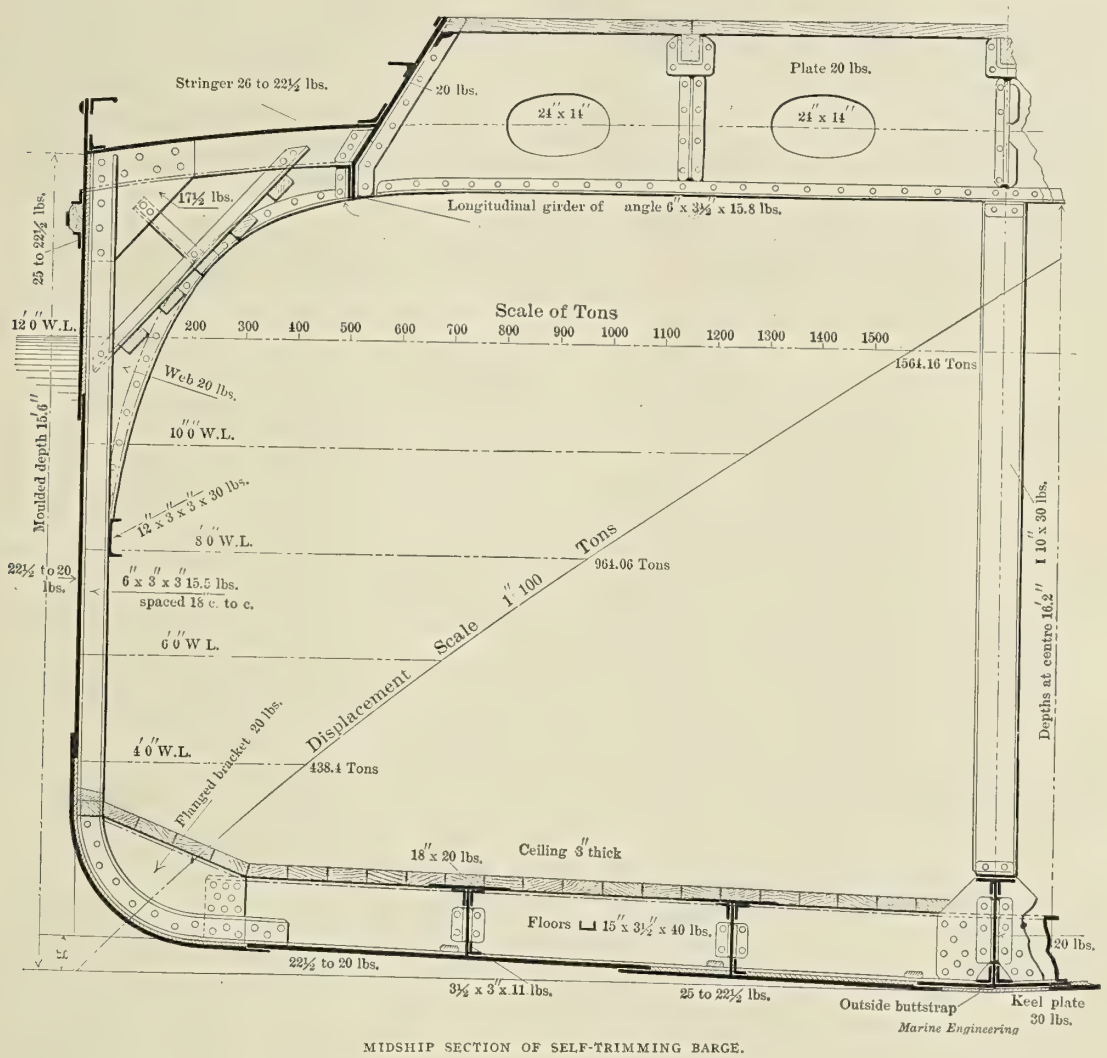
The plans reproduced on this page and the one following, are those of a "self-trimming" barge specially designed by one of our correspondents for the coal-carrying trade; and although, taken in the abstract, few of the features may be said to be absolutely




INBOARD PROFILE AND DECK PLAN OF SELF-TRIMMING BARGE.

original, the design as a whole is worthy of special consideration, both from a standpoint of efficiency as well as from an economical point of view in the handling.

The scantlings throughout are of mild steel considerably in excess of those required to meet the demands of any classification society from which a rating would be sought, but it should be remembered that the hard usages to which such crafts are generally subjected make it a matter of necessity to discard the question of initial cost in order to secure permanent efficiency, which in such cases is of paramount importance to the owner. And, unless due care is exercised in a judicious repartition of the weights as well as proper attention paid to the question of fastenings, the excessive strains such vessels are called upon to withstand, either when afloat or more often when aground, are liable to develop weaknesses and structural defects which subsequently become a constant source of expense to those who own them.


Stringer 26 to 22½ lbs.
20 lbs.
Plate 20 lbs.
24" x 14"
24" x 14"
17½ lbs.
Longitudinal girder of angle 6" x 3½" x 15.8 lbs.
25 to 22½ lbs.
Scale of Tons
200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500
12' 0" W.L.
1564.16 Tons
Web 20 lbs.
10' 0" W.L.
Moulded depth 15'6"
12" x 3" x 3" x 30 lbs.
8' 0" W.L.
964.06 Tons
22½ to 20 lbs.
6" x 3" x 3" 15.5 lbs. spaced 18 c. to c.
6' 0" W.L.
Displacement Scale 1" 100 Tons
4' 0" W.L.
438.4 Tons
Flanged bracket 20 lbs.
18" x 20 lbs.
Ceiling 3" thick
Floors ⌊ 15" x 3½" x 40 lbs.
I 10" x 30 lbs.
Depths at centre 16'2"
20 lbs.
22½ to 20 lbs.
3½ x 3" x 11 lbs.
25 to 22½ lbs.
Outside buttstrap
Keel plate 30 lbs.
Marine Engineering

MIDSHIP SECTION OF SELF-TRIMMING BARGE.

In this particular case every effort has been made to simplify the construction, at the same time retaining the maximum of efficiency. The web frames, as shown on the midship section, form a complete transverse tie from side to side, being fitted in conjunction with through beams (twelve in number), as indicated on the sectional elevation.

The floors, of channel section, 15 by 3½ by 3½ inches by 40 pounds, are in one piece from the middle line to the lower turn of the bilge, where they are connected to the frames by substantial bracket plates. Two intercostal girders, formed of 20-pound plates and angles, are fitted on each side between the center keelson and bilges, and these girders are completed, as an important item to resist longitudinal strains, by a continuous rider plate 18 inches by 20 pounds riveted to the upper angles and the top of the floors, as well as to the bottom shell plating, to which they are connected by 3½-inch clips.

The center keelson is continuous and forms the backbone of the vessel; and, in order to avoid joggling the lower keelson bars, the flat plate keel, which is of 30 pounds weight per square foot, has been fitted as an "inside strake," and the butt strap (treble riveted) fitted outside in one piece.

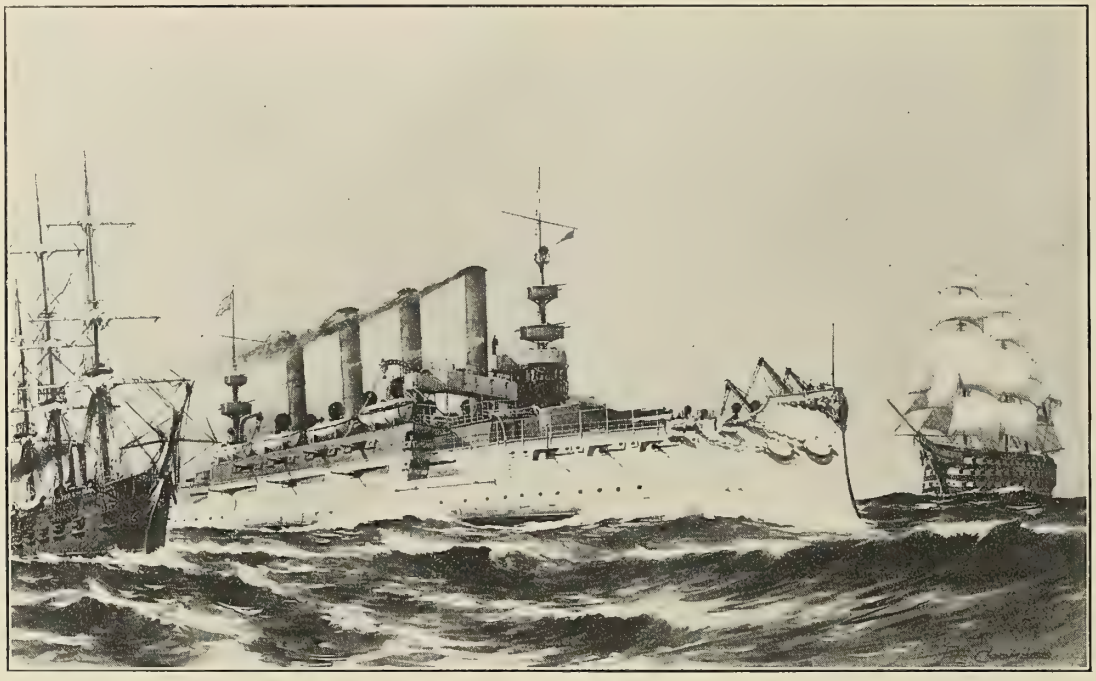
Substantial pillars of I-section, 10 inches by 30 pounds, are fitted at the middle line under each of the through beams, and form a strong tie between the bottom of the vessel and the deck beams.

A further reference to the plans will show that the hold, from bulkhead to bulkhead, has been left entirely free for the cargo, which may be poured in indiscriminately or removed by the most modern methods generally employed in such cases, without hindrance or loss of time. This barge will carry about 1,080 tons on 12 feet mean draft of water. The hatchways (three in number), 31 feet 6 inches by 22 feet, are such as to be convenient for any kind of freight, and if coal or any other bulk cargo is carried the "wing-boards" fitted at the sides are intended to avoid the possibility of such cargo ever shifting in a rolling sea, as well as the expense of trimming. H. W.

---

Mr. Hollis Burgess has succeeded Burgess & Packard in a yacht brokerage business at 10 Tremont street, Boston.

Mr. T. S. Marvel, shipbuilder, of Newburg, N. Y., has formed the T. S. Marvel Shipbuilding Company, and will continue the business under that name.



THE THREE UNITED STATES SHIPS PENNSYLVANIA.

### Three Generations of the Pennsylvania.

We present on this page a reproduction from a drawing, showing three ships which have at different times been carried on the list of the United States Navy, all of which have been named *Pennsylvania*. The successive transition from the old sailing ship of nearly a century ago to the steam frigate of the time of the civil war, and then to the armored cruiser of the present day, is much greater in the actual fighting qualities of the ships than in the appearance, great as that is.

The first of these three ships was the first and only three-decker built for the United States Navy, and is said to have been the largest ship built in this country prior to the civil war, her displacement having been 3,241 tons. Built in Philadelphia in 1837, she was manned by a crew of upward of 1,100 men, and had a

THE ARMORED CRUISER PENNSYLVANIA, IN THE DELAWARE RIVER.

(Copyright, 1905, J. W. Dawson, Philadelphia.)

battery of no less than 120 guns. She was too cumbersome to be used on ordinary cruises and, as the result, made only one in the service of the country. In 1861, when the Union forces burned the navy yard at Norfolk, to prevent its falling into the hands of the Confederates, this ship was among those destroyed.

The second ship of the name was started in 1864, at the works of Harrison Loring, in Boston, and dragged along for several years, but was never completed, or even launched. The machinery was under construction at the Boston Navy Yard. This ship was one of a class of eight vessels, measuring 312 feet 6 inches in length by 46 feet in beam; her displacement was 3,953 tons, while the gross tonnage was 3,177. The ship was originally known as the *Kewaydin,* the name being changed to *Pennsylvania* in 1869, and the ship condemned and sold in 1874.

One of the *Georgia* class of battleships now under construction was given the name of *Pennsylvania,* but before the ship was actually laid down the name was transferred to one of the armored cruisers authorized just after the war with Spain. This cruiser, which has recently been placed in service, has a displacement of 13,680 tons and a speed of 22 knots. The length is 502 feet, beam 69 feet 6 inches, and draft 24 feet 6 inches. The battery consists of four 8-inch and fourteen 6-inch rifles of the rapid-fire type, together with nearly fifty smaller guns. She was built by the William Cramp and Sons' Shipbuilding Company, in Philadelphia.

### A Type of Army Vessel.

The accompanying photograph shows one of two sister ships completed last year by the Pusey & Jones Company, of Wilmington, Del., for the quartermaster's department of the United States Army, namely, the *General Nathaniel Greene* and the *General Thomas S. Jesup.* Their principal dimensions are:

| | Ft. | Ins. |
|---|---|---|
| Length on deck | 130 | 0 |
| " " load water line (9-ft. draft) | 123 | 4 |
| " (American Bureau) | 119 | 0 |
| Breadth, molded | 27 | 0 |
| Depth, " | 12 | 4 |
| Displacement (9-ft. draft), including 70 tons of feed water, coal, and cargo | 428 tons | |

They are staunch little vessels, built under special survey of the American Bureau of Shipping, and designed for a speed at load displacement and under natural draft of 13 statute miles per hour. Both steamers were finished within contract time, and maintained a speed for a continuous run of four hours of over 13.2 miles per hour, with allowance for tide. The trials were run on the Delaware River and the tide factor was eliminated in the following manner: An endurance run was first made over a measured course of 26 miles and return without stop. This was to be covered in four hours. The usual gauge, temperature, and

ARMORED CRUISER PENNSYLVANIA, IN DRY DOCK.

(Copyright, 1905, J. W. Dawson, Philadelphia.)

revolution counter readings and cards were taken every fifteen minutes. Both vessels made this run with some minutes to spare, but it was not considered that steaming half way with the tide and the other half against the tide satisfactorily eliminated the tide factor. So three pairs of standardization runs were made over a measured mile course, the first at a high steam pressure, the second at an intermediate steam pressure, and the third at a steam pressure low enough to insure the speeds being below thirteen miles per hour. The principal readings on these runs were the elapsed time and the total revolutions for that time. The average speed per hour and revolutions per minute for each pair of runs was then calculated and a curve laid off with the former as one ordinate and the latter as the other. Then the average revolutions per minute for the entire endurance run was found and spotted on this curve. The speed corresponding to this number of revolutions as determined by the curve was taken as the actual speed of the vessel on her four-hour run.

The engine is a vertical inverted compound with cylinders 20 and 40 inches diameter and a stroke of 24 inches. It is constructed in accordance with the most up-to-date practice, with a built-in condenser, independent air pumps, and box guides. Steam is supplied by two Scotch boilers 9 feet 9 inches inside diameter

A NEW ARMY STEAMER.

and 10 feet 6 inches over heads, at 150 pounds working pressure. Each has two corrugated furnaces with 33 square feet of grate surface, and each boiler has 1,003 square feet of heating surface. The cast-steel propeller is of the four-bladed built-up type, 8 feet 4 inches diameter and 11 feet 3 inches pitch, right-hand, true screw. The pitch can be adjusted from 10 feet 1 inch to 12 feet 5 inches.

The general arrangement of the steamer may be briefly outlined as follows:

Beginning at the stem, there is a trimming tank extending to the deck and 9 feet 5 inches fore-and-aft, with a capacity of 8 tons of water. Aft of this is the forecastle, 10 feet 8 inches long, with accommodations for seven men. The chain locker and a store room are underneath the forecastle, access to both being obtained from the fore hold. This latter is 26 feet 3 inches long. At its after end is placed a four-drum steam hoisting engine with levers on deck for operating the six-ton cargo boom shown in the photograph. There are two 14-inch diameter drums for the hoist and topping lift and two 12-inch diameter drums for the range port and starboard. Under the wood ceiling of the hold for 14 feet 3 inches forward of the boiler-room steel bulkhead is a built-in boiler feed tank of fifteen tons capacity. A 400-gallon galley tank is located near the hoister.

The boiler room is 33 feet 3 inches long; the boilers are arranged fore-and-aft with the fire room between them and coal bunkers of 90-tons combined capacity port and starboard. A steel bulkhead separates the boiler and engine rooms and to its after side are fastened a number of the auxiliaries. The engine is handled from below on the starboard side, and on this side is also located the electric plant, consisting of a 7-Kw. direct-connected marine generating set. The electric equipment includes a 13-inch searchlight. From the aft boiler-room bulkhead to the after-peak bulkhead is a distance of 28 feet, and just forward of the latter are rooms for the engineers, port and starboard, well fitted up, and with one berth each. From each room a ventilator leads to the upper deck. The engineers' work bench is against the bulkhead and between the two rooms. The capacity of the after-peak tank is 8 tons, and it is limited by a watertight flat 4 feet below the main deck, which allows of ready access to the quadrant, and provides stowage for the spare tiller, etc.

The deck house is of steel, its total length forward and aft at the center line being 82 feet 7 inches. This leaves 43 feet 5 inches deck room forward and 4 feet aft, with a passage around the after part of the house as shown. A wooden bulkhead aft of the after gangway separates the officers' cabin from the rest of the house, and a separate toilet room is provided for them behind it. The steel engine and boiler casing, 35 by 11 feet, starts 17 feet 6 inches from the forward end of the house, with the galley and mess room over the after boiler. The crew's toilet room is just forward of the aft gangway on the port side of the ship. Seats are arranged along both sides of the midship house except in way of the coal ports shown in the photograph. Coal is led from these to three 20-inch deck scuttles through portable iron chutes.

In the engine and boiler casing and at its after end are stairways leading to the upper deck, whose general arrangement can be clearly seen. Three of the lifeboats are 22 feet long and one 16 feet long. In the pilot house is a combined steam- and hand-steering gear having one wheel, 5 feet 6 inches diameter, for both, and connection is made by shafting and bevel gears to a steam-steering engine on a raised platform just forward of the engine and boiler casing. The captain's state room is aft of the pilot house. The air ports in the hull are 8-inch clear glass, the two forward ones in the forecastle being hinged to open. In the front of the house are six 15-inch air ports.

The equipment includes two stockless anchors and 110 fathoms of chain. The windlass is of the tub-boat type with double cast-iron bitts. Awnings are provided for the upper deck and for the main deck forward. On the latter the cargo boom acts as a ridge pole. As can be seen from the foregoing, everything about these steamers is arranged with an eye for the greatest convenience and practical utility, and it is not often that the needs and possible requirements of a boat of this type are so fully provided for.

H. H. T.

---

### French Shipping.

The French merchant marine continues to suffer acutely from an apparently insuperable difficulty—lack of outgoing freight. In Marseille, for example, decidedly the most important French port, against 4,666,198 tons of goods imported during 1903, but 2,170,212 tons were exported. Added to this vital complaint of ship owners is the increased cost of operating French ships compared with those of other nations, and, by no means least of all, troubles with labor.

The statistics of the port of Marseille continue to demonstrate the increasing sea power of the smaller maritime nations operating cheaper ships with cheaper men than either Great Britain or France. While the amount of merchandise landed and shipped from Marseille from 1900 to 1903, inclusive, increased by 936,335 tons, French ships benefited by only 163,252 tons of increase and British ships by only 89,726 tons. During the same interval the freight going out and coming in on ships of other foreign nations increased by 683,357 tons. Three Mediterranean nations show increases in the last three years greater or almost as great as those of Great Britain or France, namely: Italy, 183,000 tons; Greece, 199,208 tons, and Spain, 142,318 tons.—*Daily Consular Report.*

## MOTOR BOATS.—(Continued.)

BY DR. WILLIAM F. DURAND.

### THE MOTOR-BOAT ENGINE.

The problem of the engine, or of the motive power, as already outlined in the introduction, will involve questions of weight and space, economy, simplicity, reliability, adaptation, and cost. In addition to these general considerations and in a more detailed way there will be questions of proportion, size, and form, of material and workmanship, of carburetion and ignition, of lubrication and wear, and, in short, of the many points of detail which lie between the engine as it exists in the mind of the designer and in the boat of the user. The general structural arrangement of the marine internal combustion motor of the two-cycle type is well indicated in Figs. 18 and 19, showing sections through an engine of the *Western* design, while in Fig. 20, showing a section of an engine of "Standard" design, the general arrangement of a

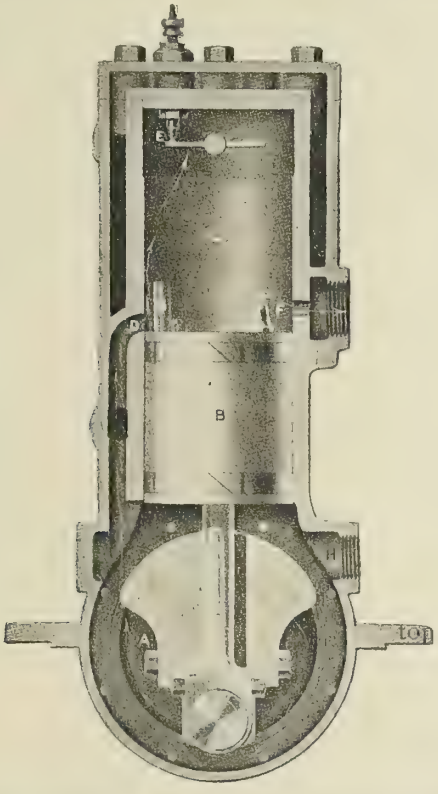



FIG. 18.—SECTION OF "WESTERN" TWO-CYCLE ENGINE.

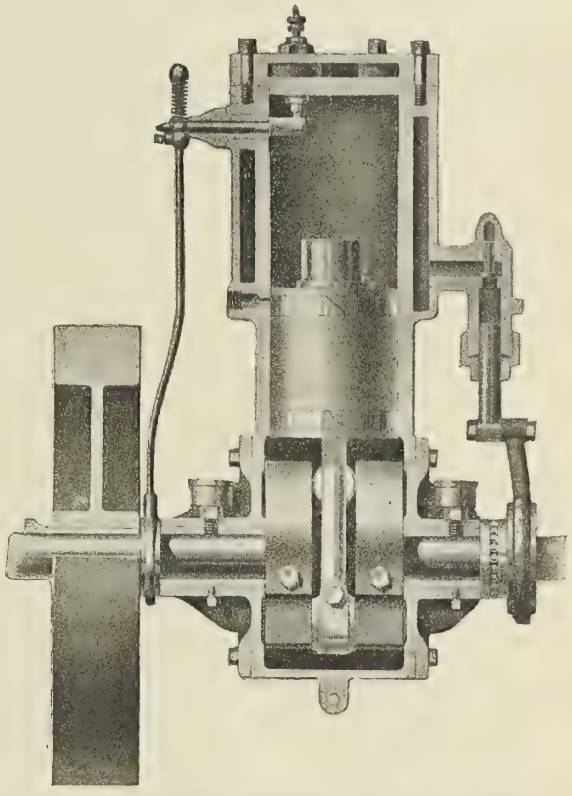


FIG. 19.—SECTION OF "WESTERN" TWO-CYCLE ENGINE.

single-cylinder four-cycle engine is likewise indicated. In either case multi-cylinder engines will require, of course, only a reduplication of similar units. An examination of these cuts in connection with the discussion of the operation of the two- and four-cycle type of engine, as found in the introductory chapter, will serve to make clear the function of the various parts here shown, and also to still further illustrate the same general principles and theory of operation. The cuts further illustrating the present article, and drawn from representative examples of modern design, will also serve to illustrate many general points of arrangement and design outside of those to which direct reference may be made.

*Weight.* Turning now to some of the special features which go to make up the problem of the engine, we find weight standing near the top in point of importance. This question has already been touched on in connection with the general discussion of the two- and four-cycle types, and it will be remembered that with the same general schedule of design the four-cycle type will be somewhat heavier than the two-cycle. Pursuing this comparison with reference to some further points of structural detail, it is clear that with the two-cycle engine the necessity of inclosing the crank case will involve a certain amount of weight which is saved in the four-cycle type, and the latter may in consequence be made sensibly lighter per cylinder so far as columns and bedplate are concerned. On the other hand, the four-cycle type must be made somewhat heavier in its valve gear and flywheel. The difference due to these items, however, will scarcely balance the relative gain due to crank case, and it thus results that per cylinder and on the same general schedule of design the four-cycle type may be made somewhat lighter than the two-cycle. On the basis of power the two-cycle type scores its most important advantage by reason of the double number of power strokes in a given time, and in consequence of which (with all other conditions the same) the power developed in the two-cycle type would be twice that in the four-cycle. This advantage is discounted, however, by the higher revolutions practicable with the four-cycle type, and by the somewhat higher thermodynamic efficiency of its cycle, as already noted.

On the final power basis these various relative gains and losses are likely to leave the advantage slightly with the two-cycle type, comparing on the same general schedule of design. So far as actual practice goes, however, the four-cycle type scores a signal advantage in having attracted much more attention and study on the part of engineers and skilled designers, especially for engines of moderate to large power. It thus results that in the best practice of the day with four-cycle engines, every advantage is taken of special materials and of their most economical disposition and use, and all in such manner as to realize the needed strength on the minimum of weight and space. Large engines, furthermore, gain in economy of weight per unit of power, so that with the best practice of the day, four-cycle engines in typical sizes, or from 10 to 100 horsepower and upward, are very much lighter per unit of power than two-cycle engines, also in typical sizes, or from 2 to 10 horsepower.

Between the two types of engine there is, after all, but little contest so far as possession of the field is concerned. For engines of moderate to large size, and where economy, reliability, and durability are of importance, the four-cycle type must be conceded to be typical; while on the other hand for small sizes, and where

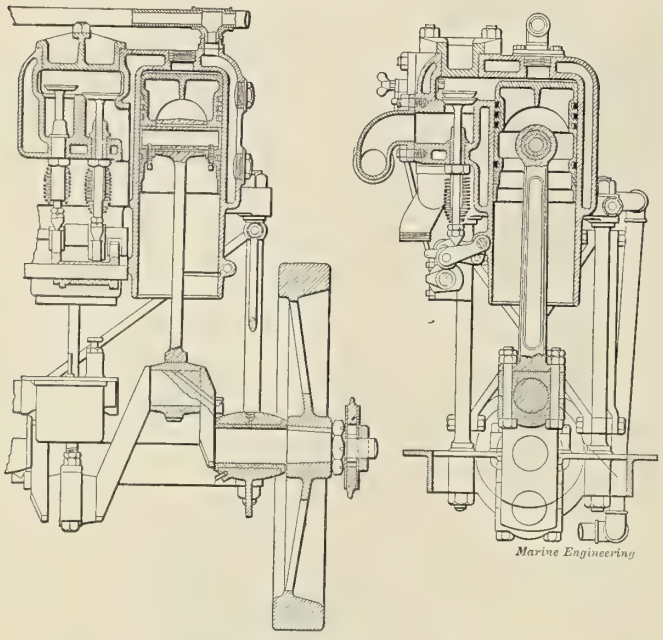



FIG. 20.—SECTIONS OF "STANDARD" FOUR-CYCLE ENGINE.

compactness, simplicity, and low first cost are of importance, the two-cycle type may properly claim full recognition.

In moderate or large sizes, or from 10 horsepower to 100 and over, four-cycle engines are quoted from an upper range of 60 or 80 pounds down to 10 pounds or less per horsepower, lighter as the size of the unit increases, and according to the style of design. To a certain extent there is coming to be a differentiation in the field of design into common and so-called "auto" or high-speed practice. In the latter the weights may be expected to vary from perhaps 20 pounds per horsepower down to 10 or less, while in the former the ordinary range is found perhaps between 40 and 80, or even up to 100 and over in small sizes. For two-cycle engines the weights in sizes from 1 to 5 horsepower are found usually between 50 and 100 pounds per horsepower.

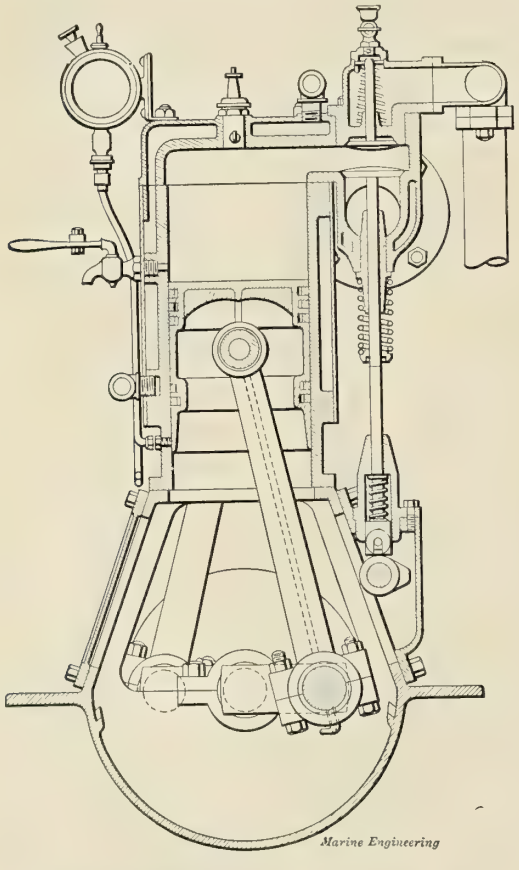



FIG. 21.—SECTION OF "LAMB" FOUR-CYCLE ENGINE.

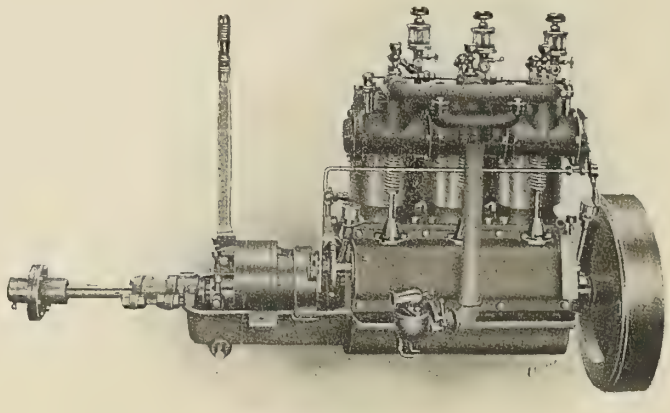


FIG. 22.—THREE CYLINDER, FOUR-CYCLE "LAMB" ENGINE, STARBOARD SIDE.

These figures again illustrate the fact above noted that the field of operation is fairly well divided between the two types, the two-cycle being found only in small sizes, and the four-cycle being restricted for the most part to medium and large sizes; and that while on the same schedule of design and in the same sizes the two-cycle engine may be made somewhat lighter, actually the lighter constructions are in the four-cycle type because the schedules of design and the sizes are not the same, and the four-cycle type gains in marked degree both by reason of its size and the special design in which such engines are made when high speeds are desired.

In quoting the weights of engines there is much diversity with regard to including the weight of the flywheel. It is clear that with so considerable an item either omitted or included, a very considerable difference will result in the weight, and in order to properly interpret any given figures it should be definitely known whether they include the flywheel or not. Since it is a necessary feature of the operation of the engine it should, of course, be included.

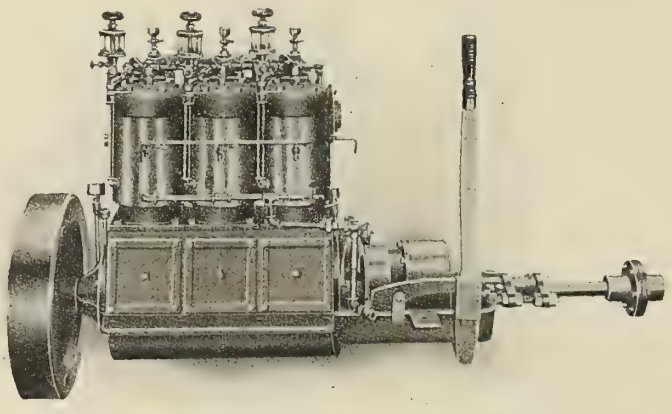


FIG. 23.—THREE CYLINDER, FOUR-CYCLE "LAMB" ENGINE, PORT SIDE.

*Details of Design.* The limits of the present series of articles will not permit of any general discussion of the problem of design. There are, however, certain special points to which brief reference may be made.

We first note, as shown in the various cuts, that the typical marine internal combustion engine is of the single-acting type with

half-trunk piston, thus avoiding the use of the usual crosshead connection between piston and crank. This mode of connection, as well as the need of broad rubbing surfaces, gives to the piston its typical form, so distinctly different from the shallow piston employed in the common type of steam engine. This again leads to the long cylinder bore met with in all engines of this type. The relation between stroke and diameter is very commonly one to one, while occasionally the stroke is slightly greater than the diameter. The actual length of cylinder, however, including the length of piston and length for the clearance in which the gases are compressed, is very commonly between two and three times the diameter of the bore.

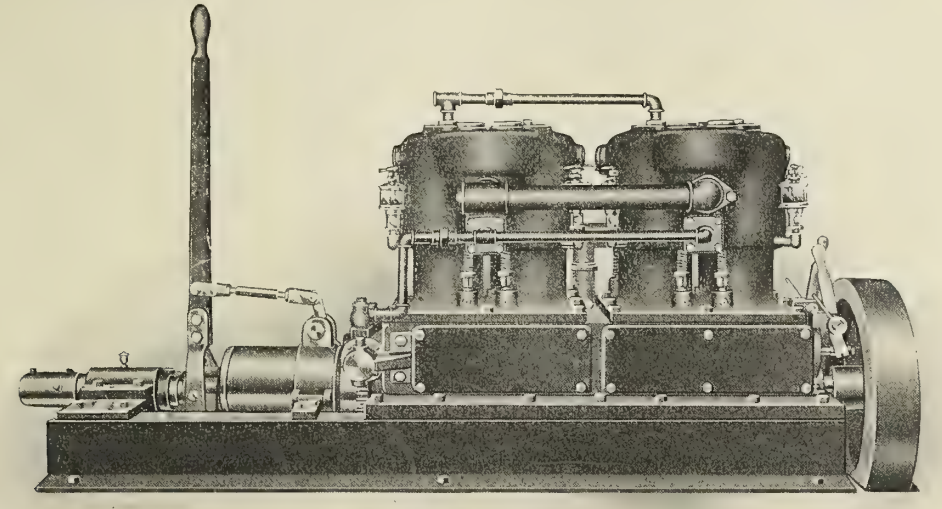


FIG. 25.—FOUR CYLINDER, FOUR-CYCLE "EAGLE" ENGINE.

In the two-cycle type the frame and bedplate are very commonly cast together with the cylinder, the casting containing likewise the inlet and exhaust passages and cylinder-jacket space.

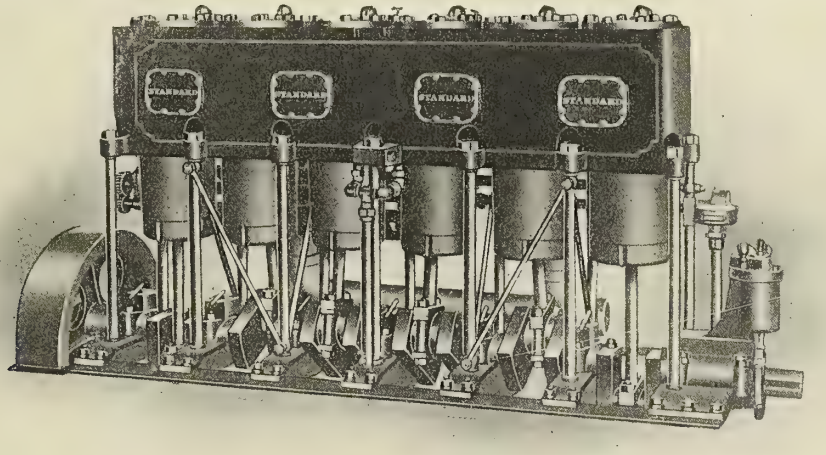



FIG. 26.—SIX CYLINDER, FOUR-CYCLE "STANDARD" ENGINE.

In the four-cycle type the cylinder frame and bedplate are also in some cases either cast together or are constructed of cast metal mounted up as a solid structure, and as shown in several of the illustrative cuts. In other cases, where saving of weight is of importance, the framing is made of light steel columns, very similar in style to the so-called torpedo-boat type with the steam engine, and as shown in Fig. 27.

The form of the piston has already been referred to. In all first-class designs special attention is given to the piston packing. Usually two sets of spring rings are fitted, one set near each end, and two or three rings in each set. Leaky piston rings, in addition to the direct loss by leakage on the power stroke, seriously disturb the operation of the engine by preventing proper compression, and thus interfering with the efficiency and completeness of combustion. For these reasons the piston packing is a matter of serious moment, and one to which designers and builders must give special care, and users must endeavor to maintain by careful lubrication and general watchfulness.

In the matter of the moving parts generally, modern practice has made great advances, both in form and proportion and in the materials employed. Large power on small weight means special care in the disposition of material, and special provision in the size and proportion of joints and rubbing surfaces. A comparison between the sizes and proportions of the crank pins and main shaft bearings under present conditions, and those prevailing in the practice of a few years ago, will show one of the principal means by which the present extreme results are obtainable. Special bronzes of tensile strength running to 70,000 or 80,000 pounds per square inch, and special steels running to 140,000 or 150,000 pounds, are used for rods and shafting, especially in the leading European practice with designs for forced output.

Turning to valve gear, in the two-cycle type there are no valves for distribution to the engine, and only such valves are required as may serve to control the supply of gasoline to the carburetor, or to serve as throttle between the latter and the crank case. This item makes for simplicity and is one of the principal features tending toward lower first cost in this type of engine. In the four-cycle type each cylinder must be fitted with an inlet and an exhaust valve. These are commonly of the disk or poppet form and are usually of about the same size and in some cases interchangeable. The inlet valves are made either

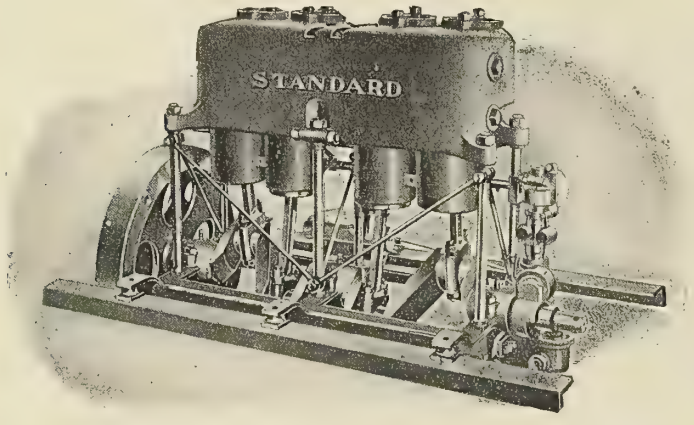



FIG. 24.—FOUR CYLINDER, FOUR-CYCLE "STANDARD" ENGINE.

automatic in operation or driven by a suitable gear. The automatic valve operates in manner exactly similar to the valve of an ordinary pump, opening when the pressure within the cylinder falls below that within the carburetor, and closing when it rises above. For moderate revolutions such mode of operation will be found entirely satisfactory, but for distinctively high speeds the positively driven valve will be found more definite and satisfactory in its action. The general type of positively-driven gear consists of a revolving shaft geared down so as to make one complete

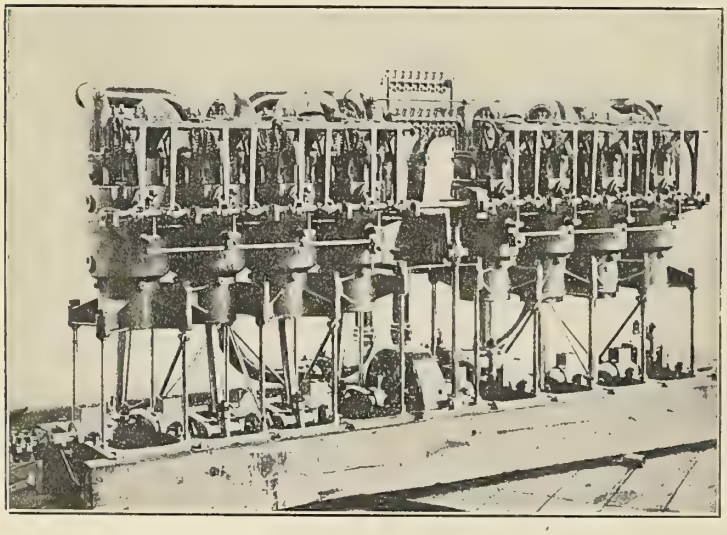


FIG. 27.—EIGHT CYLINDER, FOUR-CYCLE "CRAIG" ENGINE.

revolution for two of the engine, and carrying cams suitably arranged for the operation of the valves. One shaft may thus be used for the operation of both the inlet and exhaust valves. In the best practice water jackets surround the valve chambers and valve-stem guides, thus preventing overheating and insuring a smooth and easy working valve. The valves should be readily accessible for examination or renewal, and this requirement is usually realized by placing them in pockets covered by removable bonnets or caps. A typical arrangement of valves and valve gear with automatic inlet valve may be further illustrated by the section of Fig. 20, and a careful examination of this figure will sufficiently illustrate the main features of this general type of gear.

Regarding the item of thrust bearing, the ball bearing form for small and moderate sizes has received favorable notice, and has gained a definite status in the practice of the day. In larger sizes special forms of roller bearing are employed to some extent, while the familiar form of ring and collar thrust is still preferred by most designers.

*(To be continued.)*

## Registration of Trade-Marks.

Renewed attention to the protection of trade-marks has been directed by a new law, passed by Congress at its last session, which by its terms became effective April 1, 1905. The provisions of this law are very favorable to manufacturers who register their marks at the United States Patent Office, and a large number of manufacturers using trade-marks have already applied for registration of their marks under it. Registration under the old law could be obtained only for those trade-marks which were used in commerce with foreign states or the Indian tribes; and, in addition, many trade-marks which had been used for years and had become of great value were denied registration because of technical objections.

The new law provides for registration of trade-marks that are used in commerce, not only with foreign nations and Indian tribes, but also *between the states.* It likewise contains a new and valuable provision to the effect that all trade-marks in the exclusive use of the applicant or his predecessors in business for ten years preceding the passage of the act (February 20, 1905), may be registered. This provision is intended to permit the registration of marks to which otherwise technical objections might be made, and was particularly framed for the better protection of "old marks."

The government fee for registering a mark has been fixed at $10. This is a substantial reduction from the former fee, which was $25. The registration remains in force for twenty years, and may upon application, made not later than six months before the expiration of the term, be renewed for a like period.

Privileges of registration are extended to those aliens whose countries afford similar privileges to citizens of the United States. The following foreign countries have trade-mark treaties with the United States: Austria-Hungary, Belgium, Denmark, France, Germany, Great Britain, Italy, Japan, Russia, Servia, and Spain. The laws of Switzerland and the Netherlands are similar to our own in limiting registration to those aliens whose countries afford similar privileges to the citizens of those countries.

It is required of aliens, however, that they shall first have registered the mark in their own country before being entitled to registration here.

Section 5 of the new law specifies certain marks not entitled to registration. These are: those containing immoral or scandalous matter; those containing the flag or coat of arms of the United States, or of any state or foreign government, or any simulation thereof; those conflicting with a known or registered mark applied to goods of the same descriptive properties; those consisting merely in the name of an individual, firm, etc., unless printed or woven in some particular or distinctive manner, or used in connection with a portrait of the individual; those consisting merely of the portrait of a living individual unless with his written consent; those descriptive of the goods, their character or quality; those consisting merely of a geographical name or term.

Marks already registered under the old law must be re-registered under the new law to become entitled to its liberal provisions.

---

Mr. J. R. McColl, associate professor of steam engineering at Purdue University, has resigned his position for one in the engineering department of the American Blower Company, Detroit.

### A National Motor Boat Carnival.

It is announced that a motor boat carnival, under the auspices of the National Association of Engine and Boat Manufacturers, will be held on the Hudson River on September 14, 15, and 16. The start will be at a point opposite Ninety-seventh street. The iron steamboat *Sirius* has been chartered for the use of members, guests, and officials.

The carnival will consist in races for boats of various classes, all of which must be propelled by either hydro-carbon or electric motors. The classification into which the boats are divided are high-speed motor boats, cruisers, and open launches. Under the first heading are subdivisions, of which the first includes all boats not over 40 feet in length; the second includes all boats over 40 feet; and the third all boats under 33 feet. Under the second division there are two classes, separating at a length of 50 feet, while the open launches are all to be under 50 feet in length. Applications for entry blanks and other information should be made to Mr. Hugh S. Gambel, secretary, 314 Madison avenue, New York city.

### New Austrian Torpedo Craft.

The Austro-Hungarian government has evolved a new scheme in the standardization of machinery for torpedo boats and torpedo boat destroyers, having recently let a contract to Messrs. Yarrow & Company, of London, for one ship of each class, which are to be used as patterns for future construction in Austrian naval yards. The destroyers have a displacement of 390 tons, and the speed will be 28 knots when the engines are developing 6,000 horse power. The torpedo boats will be of the first class and will displace 200 tons. With 3,000 horse power, a speed of 25 knots is anticipated.

The main point of interest, however, is that the machinery of the two classes will be interchangeable, because of the fact that the destroyers will have twin screws, each actuated by an engine of 3,000 horsepower, while the entire power in the torpedo boats will be used to operate a single screw. This will enable the naval stations to carry a much smaller supply of spare parts than would be the case if these engines were not all of the same size, and will much facilitate repairs and renewals whenever these are found to be necessary. It is intended to make this fleet at present consist of 12 destroyers and 36 torpedo boats, of which the first in each class is to be built in London, as mentioned above.

### Warm Work.

*Editor* Marine Engineering:

Some years ago, while serving as an engineer on an Atlantic liner, I was early one morning called on to do an emergency job. A fusible plug had blown out on top of one of the combustion chambers. The boiler had two furnaces, with a combustion chamber common to both, and was one of a battery of eight.

When I arrived on the scene the two fires had been drawn, the boiler partly blown down, and the steam let off, and for my comfort a bed of waste matting laid on the fire bars. I crawled in on the matting and commenced tapping the defective plug for the reception of a brass bolt. Standing in the back connection I had just got started when I saw the furnace full of matting on fire. Crowded against the back wall I stood for a few seconds and watched the flames rush toward me, turn upward and dart through the tubes; then thinking a little fresh air would do me good, I got out through the other furnace, burning my hands severely on the bare grate. When the fire had burned itself out and some boards been laid on the grate I went in again and finished my job. Although at that time evidently too green to burn, I was impressed with the danger of going into a tight place on an inflammable bed, and never did it again. W. Cuthbert.

### The Disaster to the Bennington.

At about 10:15 A.M., July 21, the United States gunboat *Bennington*, which was preparing to get under way in the harbor of San Diego, Cal., suffered a disastrous catastrophy in the explosion of one of her boilers and the liberation of the steam from the other three. The force of the explosion did great damage to all parts of the vessel, and broke sea valves and pipes so that water came in and the ship began to list badly, and was finally run aground in shoal water. The list of casualties, as given out by the Navy Department, includes 62 dead, of whom two were officers, and in addition 14 were seriously and 26 slightly injured. This aggregates 102 of the entire crew of 197 men, and some of the remainder were slightly burned or scalded.

The *Bennington* had four cylindrical straight-away boilers, commonly known as low cylindrical or locomotive gunboat boilers. Each was 17 feet 9 inches long, with a diameter of 9 feet 9 inches, and the original design called for the carrying of 160 pounds of steam. It was a well-known fact, however, that the boilers were weak, and the last log received at the Navy Department shows that the safety valves were set at 145 pounds, and that the boilers were usually forced not above 135 or 140 pounds. They were fifteen years old, but had been retubed about eighteen months ago. The rear admiral in command of the Pacific fleet reported to the department last year that the boilers were in need of repairs, but that the matter was not urgent; while a report about the same time from the engineering officer of the ship showed that the boilers were generally in poor condition, but that their internal condition was supposed to be good. Temporary repairs on these boilers were made at the Mare Island navy yard last May.

The report of the court of inquiry into this disaster has just been published, although its substance was known. This report finds that boiler B of the *Bennington* exploded, partly because of its being subjected to an abnormally high pressure, and because the metal of the crown sheet of the furnace, and the bolts holding that crown sheet in place, had become excessively fatigued by the alternate expansion and contraction due to the extreme differences in temperature to which they had been subjected during their fifteen years of service. It does not appear that the shell of the boiler burst, all evidence tending to support the belief that the furnace burst inward, and that the water, being suddenly reduced in pressure below its boiling point at the existent temperature, suddenly flashed into steam in such quantities as to completely fill nearly every part of the vessel. To add to the quantity liberated by this means it is probable that steam from the other boilers was drawn through the common steam pipes connecting all boilers, and had a large share in causing the tremendous loss of life above noted. It appears from information at hand that the machinery, at the time the accident occurred, was in charge of an ensign who had had a little more that six months' engineering experience; and this, in a ship which had formerly carried a chief engineer, a past assistant engineer, and an assistant engineer. There was no warrant machinist on board, and, indeed, no such official has ever been attached to the *Bennington*, and it goes without saying that no engineer of the old corps was available for service on the ship.

The *Bennington* is described as a steel unarmored gunboat with a displacement of 1,700 tons, a length of 230 feet, a beam of 36 feet, and a draft of 14 feet. The machinery consisted of the four boilers above mentioned, which had an aggregate grate surface of 220 square feet, and a heating surface of 8,210 square feet; and twin-screw, horizontal, triple-expansion engines with cylinders measuring 22, 31, and 50 inches in diameter, and a stroke of 30 inches. This machinery developed on trial about 3,400 horsepower, and gave the ship a speed of 17.5 knots.

We are commenting editorially upon this disaster and its causes.

Messrs. Lorillard & Walker, of 41 Wall street, New York, have succeeded Mr. Frank N. Tandy as yacht broker in New York and Boston.

# Marine Engineering

Published Monthly by

MARINE ENGINEERING
INCORPORATED.

17 Battery Place, - - NEW YORK
12 St. Benet Place, Gracechurch St., LONDON, E. C.

H. L. ALDRICH, President and Treasurer

PROF. W. F. DURAND, Advisory Editor

SIDNEY GRAVES KOON, Editor

GEORGE SLATE,
Vice-President and Advertising Representative

Branch Offices. Philadelphia, Pa., Machinery Dept., The Bourse, S. W. ANNESS.
Boston, Mass., 170 Summer St., S. I. CARPENTER.

TERMS OF SUBSCRIPTION.

| | Per Year. | Per Copy. |
|---|---|---|
| United States, Canada and Mexico | $2.00 | 20 cents |
| Other countries in Postal Union | 10/6 | 1/- |

Entered at New York Post Office as second-class matter.



Notice to Advertisers.

*Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.*


*The edition of the September issue of Marine Engineering comprises 5,500 copies. We have no free list, accept no return copies, and only issue enough to supply the regular demand, so that the 5,500 copies represent legitimate circulation.*

### The Disaster to the Bennington.

Since the beginning of things in the United States Navy, there has been, with possibly one exception, no accident comparable with that which overtook the *Bennington*, late in July, in San Diego harbor. The exception to which we refer was the terrific explosion of a new rifled gun on the United States ship *Princeton*, in 1844, as the result of which a large number of men were killed and others injured, the death list including an unusually large number of distinguished officials, among whom were the Secretary of the Navy and the Secretary of State.

It is impossible to attribute the cause of the present disaster to negligence on the part of anyone connected with the ship. The ensign who was in charge of the machinery at the time of the explosion had had an utterly insufficient amount of experience in connection with engineering work; but his position on the ship was the result, not of his own initiative, but of a system which, during the last six years, has well nigh destroyed the efficiency of the engineering corps of the United States Navy. In his last official report as Engineer-in-chief of the Navy, Rear Admiral Melville declared that the machinery of our naval vessels was deteriorating, and he attributed this declining efficiency to the Naval Personnel Act of 1899. He has recently been quoted as saying:

"There cannot be an efficient navy in any nation without an efficient engineer corps. Great Britain has the greatest and best Navy and the best engineer corps. Unfortunately for America, we have now no engineer corps, though we used to have the best in the world."

In his report, dated October 1, 1904, Rear Admiral Rae states:

"There is no doubt that an insufficient quantity of engineering duty has been performed by the younger line officers to properly qualify them for filling the higher engineering positions at sea. The cause is well known—a lack of officers. If no other way can be found, it would be to the advantage of the country to place out of commission the requisite number of vessels now in service, in order to obtain the officers for this vital necessity. The lack of experienced men is felt in a great many vessels, as shown by numerous reports received. There are several cases on record where the engineering departments of vessels have suffered materially on account of the utter unsuitability and inexperience of the men in the engineering force."

"A little knowledge" in the engine room is a dangerous thing; and the fact that a man has passed a creditable examination after a four years' course in the Naval Academy is not a sufficient guarantee that he will make an efficient engineer. The United States government requires that a merchant ship of 3,400 horsepower shall carry not less than three licensed engineers; while it may be assumed, from what we know of the matter, that *not a man connected with the engineering force on the Bennington would have been able to obtain a license.*

In an editorial in our issue for June, we called attention to the extreme importance of having trained and thoroughly competent men to look after the expensive and complicated machinery of our warships. A man whose whole life has been devoted to this service is none too well equipped for the arduous duties devolving upon the chief engineer on a modern warship, and the least that can be done by the officials in charge of the department, is to adopt some method by which competent men, and competent men only, shall be given positions of such responsibility. So long as conditions persist such as those existing prior to 1899, and seem to point to the conclusion that social qualifications and opportunities are of much more importance to the officers of the Navy than the proper performance of technical duties connected with the operation of the ships, and particularly of the machinery thereof, it will, we suppose, be utterly out of the question for us to expect a return to anything similar to the old engineer corps, which had proven its great efficiency in the day of trial and stress of war, and had demonstrated in every way its peculiar fitness for the work required of it. It is not, however, unlikely that Congress will see fit to make some change in the Personnel Law, which will

tend to bring about results such as ought to obtain in the service. While it is a desirability that the engineering officer in charge of machinery should be well educated and have a good theoretical knowledge, it is an absolute necessity that he should be a practical engine driver and mechanic; and this can be acquired only by experience extending over years of practice.

The whole thing seems to point to the necessity of making proper provision in numbers, rank, and conditions of service for a corps of warrant machinists, or engineer officers under some other name, but performing the particular duties usually devolving upon warrant machinists, sufficient to take care of the engineer needs of the Navy in ships built and building, and to allow the necessary proportion of shore duty to these officers to render them perfectly contented with their position in the service. Our issue for June contained a communication from an engineer officer, not in the Navy, in which the present system was highly commended, though the lack of officers so far as numbers are concerned was greatly deplored; and that communication furnished the basis for the editorial in that issue to which we have above referred. There seems to be a general idea afloat in the minds of those in charge of things in Washington, and particularly in the minds of those who conceived and carried to enactment the Personnel Bill of 1899, that, as voiced by our correspondent above mentioned, the "Jack of all trades" is the proper man to put in charge of the engine room. In our editorial three months ago, we endeavored to show the fallacy of this point of view; and it is more than certain that the disaster to the *Bennington* forms a strong point in favor of our contention. While, as we have already said, the ensign in charge of the machinery at the time of the explosion cannot be held personally responsible for either the fact of the explosion or the conditions which led to that fact, it is none the less certain that his position on the ship was an entirely false one, owing to his being in a certain sense what we have referred to as a "Jack of all trades," and what is sometimes known by the concurrent expression, "master of none."

The engineer proposition in our Navy is a very live one, and one which demands not only the most careful attention possible to be given it by those in authority, but also immediate attention and action on the part of Congress to provide some suitable force for taking care of the machinery now exposed to what may possibly prove to be a series of accidents of which that to the *Bennington* is only the first. It cannot be too strongly urged that an efficient engineer corps is in many respects the strongest element conducing to an efficient navy, and that the system by which this corps is degraded and rendered almost impotent in face of danger by the methods now in vogue cannot be too strongly condemned. It is certainly as Admiral Melville says: "We have now no engineer corps, though we used to have the best in the world."

It is equally certain, however, that so long as the warrant machinist is kept in his present position, as regards opportunity for advancement to command rank, it will be utterly impossible to obtain in the service the very sort of men who ought to be there, namely: men whose education has been of such a character and extent as to enable them to properly fill the highest position to which such advancement might bring them. So long as no opportunities are offered which would be inducements to men of the character and education desired in the service, there will be little opportunity of improving the quality of the men accepting appointments as warrant machinists, and it is precisely these men on whom we will have to depend for the steaming qualities—and in large measure for the fighting qualities—of our ships, whenever they may be called upon to perform active duty. Not only this, but the number of such men in the service should be increased to at least two or three times the present allotment, in order to properly provide for ships now in service and under completion; for, as reports have stated, there are no warrant officers at present available for use on the small vessels of the Navy, nor will there, under present conditions, be any available, for a long time to come.

It goes without saying that, until we have a sufficient number of engineer officers of such intelligence and capacity as to be safely entrusted with the responsibilities of handling the great machinery plants of our ships, we cannot expect to be free from continual expense and trouble resulting from accidents, or to be fit in any sense to try conclusions with a power much inferior theoretically to our own.

---

### Shipbuilding.

For the first time in many months the outlook in shipbuilding on the two coasts of the United States gives promise which is decidedly encouraging. Within the past four or five weeks there has been more done in this line in the way of contracts placed and ships started than was the case in the entire four years preceding. Important among the new ships started are two for the American-Hawaiian Steamship Company, which are to have a carrying capacity of 11,000 tons and are to be ready for delivery in eighteen months. There are also two steamers building in Philadelphia for the Ward Line, one building in Chester and Hoboken for passenger traffic between New York and Boston, another building on the Hudson for the Hudson River Day Line, and a large steamer building at Quincy, Mass., for the Southern Pacific Morgan Line, the latter being said to be the largest coasting steamer in America. Although all of these ships, with the exception of the two Ward Line steamers, are for what might be said to be essentially coasting trade, and the latter depart very little from our shores, yet the fact that so many contracts of such scope and character have been placed is exceedingly gratifying.

# ABSTRACT FROM RULES AND REGULATIONS OF THE AMERICAN BUREAU OF SHIPPING FOR SOUND, LAKE, BAY, AND RIVER STEAMERS, YACHTS AND TUGS.

EDITION OF 1904.

ARRANGED BY HARRISON S. TAFT.

(*Continued.*)

(*b*) Vessels with a middle line plate keelson on top of floors, but not having the above intercostal plates, are to have wash plates of at least 3-16 inch thick fitted in lieu of said intercostal plates, extending all fore-and-aft. Said plates shall be clipped to the shell with single clips equal to the reverse bars.

3. Hold or Side Stringers. Also see Table 5.

(*a*) When worked in connection with hold beams (Table 5) the width of said stringer plates is to be not less than 2-3 that of the main deck stringer at corresponding frames, but of the same thickness. It may be 1-2 the width of the main deck stringer if of increased thickness, so that it shall equal 2-3 the sectional area of said stringer.

(*b*) When plate side stringers are worked in connection with web frames their width must be such that they will extend inside of the web frames so as to allow a continuous working of their face bar past said web frames; the vertical flange of the face bar being riveted to the reverse bars on the web frames without any diamond plate connection. The thickness of such a plate side stringer must be equal to that of a main deck stringer.

(*c*) A plate side stringer of the usual type is to be fitted midway between the upper bilge keelson and the main deck beams in all tug-boats fitted with web frames.

## 10. Floor Clips.

Angle clips equal to the reverse bars are to be fitted on top of all floors and on all frames in way of all angle stringers, plate stringers, etc.

## 11. Continuity of Keelsons.

All bilge and hold stringer continuous angle bars are to run from stem to stern, and be secured at their ends to breast hooks. They should be worked continuously through all web frames and watertight bulkheads, with watertight staple work at the latter.

## 12. Plate Side Stringers.

All plate side stringers are to be secured to the shell plating with single clips between the frames, except on a weather deck where the gunwale bar is to be worked continuously. A continuous angle bar is to be worked at the face of the frames on all lower deck and hold stringers, said bar being riveted to the reverse bars or to clips on the frames. All hold stringers should have a face bar fitted on the under side at the inner edge of the stringer plate. Gusset plates of the same thickness as the stringer plate should be fitted at all hold beams. Bracket plates supporting the stringer plate are to be fitted at alternate frames between the hold beams.

## 13. Web Frames in Lieu of Hold Beams.

1. In lieu of hold beams, web frames, spaced from 6 to 10 frame spaces apart, can be used. Said web frames are to be in depth at least 3 1-2 times the width of the flange of the frame bar to which they are attached and are to equal the thickness of same. Said depth is to be maintained at the junction with the floor plates. Double reverse bars are to be fitted at the inner edge of the web frame plating; but they need not exceed 3 inches by 3 inches by 7 pounds.

2. Vessels on the Great Lakes carrying bulk freight should have web frames not more than 16 feet apart; of not less width than stated above, but to equal the thickness of the floor plates.

## 14. Deck and Hold Beams.

TABLE 5.—SPACING OF DECK AND HOLD BEAMS. TYPE OF HOLD STRINGERS.

| Depth from Top of Floors to Top of Lowest Tier of Regular Deck Beams Amidships. | Upper and Main Deck Beams. | Hold Beams. | Stringer Type. |
|---|---|---|---|
| 12 under 15 ft.<br>15 " 18 "<br>18 ft. and above. | On alternate frames.<br>" " "<br>" " " | .....<br>.....<br>c. Every sixth frame. | a. D A<br>D A + B P ¾ L<br>b. Plate. |

D A = double angles riveted back to back. + B P ¾ L = with a bulb plate for ¾ length amidships.
a. Located midway between upper bilge keelson and under side of said deck beam knees in one-deck vessels; but the ends of the deck beams in vessels with more than one deck.
b. See "Hold or Side Stringers" under Section No. 9.
c. Every tenth frame if extra heavy beams are used.

1. Deck beams in yachts can be from 25 to 30 percent lighter than otherwise if fitted on every frame.

2. When a steel deck, on which there is no wood decking, is less than 3-8-inch thick amidships, the deck beams are to be fitted at every frame.

3. Main deck beams are to be worked continuously through the top of a center-board trunk, with watertight staple work at same.

4. Fore-and-aft carlings at hatches are to be of the same scantling as the deck beams. Half-beams at hatches,

or at other deck openings, are to be of the same scantling as through beams, and are to be secured to the fore-and-aft carlings with double clips or forged knees.

5. When a beam is cut for a companionway a fore-and-aft carling with deck ties must be worked at said point; the same as for a hatchway.

6. Barges not fitted with propelling machinery, can have their main deck beams lighter than otherwise.

### 15. Beam Knees.

Said knees are to equal the thickness of the beam to which they are attached and are to be at least 2 1-2 times the depth of said beams on each side.

### 16. Deck Plating, Deck Stringers, and Tie Plates.

1. Stringer Plates.

(*a*) Stringer plates are to be fitted at the ends of all deck beams. They are to maintain their full midship scantling for 1-2 length amidships. At the ends they are to taper as specified; except in vessels on the Great Lakes with machinery fitted aft, where no reduction from midship scantling will be allowed abaft the 1-2 length amidships.

(*b*) The stringers on the lower deck beams can be 2-3 the width, but of the same thickness as those on the upper deck beams.

(*c*) The stringer plates on a hurricane deck; midship bridge house; poop; and topgallant forecastle are to be 2-3 the width of the main deck stringer at corresponding frames. The thickness may be 1-16 inch less than for a main deck stringer, when said main deck stringer thickness is 3-8 inch and under; but 2-16 less when said main deck stringer is over 3-8 inch thick.

(*d*) The stringer plates on a raised quarter or a raised fore deck are to equal those on the main deck in all respects. The main deck stringer in these classes of vessels should extend at least 3 frame spaces beyond the break of said raised quarter or fore deck; tapering thence from full width at said points to the width of the molded frame flange at their ends.

(*e*) The main deck stringer of all freight sailing vessels is to be 1-16 inch thicker than otherwise.

(*f*) The stringer plates on all weather decks are to be secured to the shell plating by a continuous gunwale bar; said bar on hurricane deck; full poop; enclosed bridge house or topgallant forecastle being equal to the reverse bars, but in no case heavier than 3 inches by 3 inches by 6 pounds. When a rounded gunwale is worked the gunwale bar is to be fitted at inside of said round so as to form a margin for the wood decking.

(*g*) When the tabulated thickness of the stringer plate of a barge not fitted with propelling machinery is not under 10 1-2 pounds, it may be made 2 pounds lighter than the tabulated thickness.

2. Deck Plating.

(*a*) All vessels are to have a steel deck, equal in thickness to the upper part of bulkhead plating, worked on the main deck in range of the machinery space. Said decking is to extend at least one beam space before and abaft the bulkheads at the ends of the machinery space and thence taper for two more beam spaces into the stringer plates.

(*b*) Steel decks extending the entire length of a vessel may be reduced by 1-16 inch in thickness before and abaft the 1-2 length amidships, when their midship thickness is 5-16 inch or above. Said reduction will not be allowed abaft said 1-2 length in vessels on the Great Lakes with machinery located aft.

(*c*) If a steel deck has no wood decking worked over it, it shall be 1-16 inch thicker than the upper part of the bulkhead plating. In such vessels a bulb plate strong back should be scored over the beams on the under side of the deck plating at the middle line; having double clips to the deck plating equal to reverse bars. It shall extend below deck beams sufficient to allow a satisfactory connection of the stanchions to said bulb plate.

(*d*) Butts of all deck plating shall have a two-frame space shift.

3. Tie Plates.

(*a*) Vessels of 50 tons and above, or those which are over 16-foot beam, not having steel decks, must have tie plates extending all fore-and-aft on each side of the main deck hatches or other deck openings. Also on the lower deck of a two-deck vessel. Tie plates on the main deck of freight sailing vessels are to be 1-16 inch thicker than otherwise.

(*b*) In sailing vessels of 15 tons or above, besides the above tie plates, diagonal tie plates are to run from the mast partners to the stringer plates both fore-and-aft.

(*c*) Tie plates are to be fitted on all hurricane, bridge, full poop, and topgallant forecastle decks.

(*d*) Tie plates are to be worked athwartships at the ends of all hatches, deck houses, etc., so as to take the ends of a wood decking when no steel deck is worked.

(*e*) Plates, equal to the thickness of the main deck stringer at their ends, are to be worked on the top of the deck beams under all deck winches; windlasses; steering gears; rudder stuffing boxes; bowsprit heels; butts, etc.

4. Mast Partners.

They should equal the thickness of the main deck stringer amidships. They shall extend for two beam spaces fore-and-aft when the beams are on alternate frames, but four spaces when the beams are on every frame. In width they are to be not less than twice the diameter of the hole for the mast, with a coaming ring equal in scantling to the keelson bars.

### 17. Stanchions.

1. Stanchions should be fitted to every deck beam for 1-2 the vessel's length amidships, but on alternate beams fore-and-aft of said 1-2 length. They should be worked at the center line whenever practicable, unless two rows of stanchions are adopted. In way of the shaft tunnel or for other causes, they may be fitted off the center, but not more than 24 inches; or a double row of stanchions with a sectional area of at least 2-3 of that required for a

single row may be worked. Under winches, cranes, windlasses, and other heavy weights, stanchions should be fitted to every beam. All beams at the ends of hatches are to have stanchions fitted under them.

2. When the beams are fitted on every frame, stanchions may be located under alternate beams for 1-2 length amidships, but on every fourth beam fore-and-aft of same.

3. One-deck vessels, or hurricane-deck vessels whose depth from the top of floors to the top of the main or second deck beam is 12 and under 15 feet, are to have their hold stanchions 1-4 inch larger in diameter than otherwise. When said depth is 15 feet and over the diameter is to be 1-2 inch larger than otherwise.

### 18. Bulkheads.

TABLE 6.—LOCATION OF FORWARD COLLISION BULKHEAD.

| Vessel s Length in Feet. | Under 150 | 150 under 300 | 300 and above |
|---|---|---|---|
| Aft of stem in portion of vessel's length..... | .1 L | .085 L | .075 L |

Said bulkhead is to extend to the main deck.

1. A watertight bulkhead should be fitted at each end of the machinery space; said bulkhead extending to the main deck.

2. All watertight bulkheads are to have double frame angles and be secured to an inner bottom plating with double angle bars.

3. The stern tube of steamers of less than 500 tons should be encased in a watertight compartment. In vessels of 500 tons and above, a watertight bulkhead should be worked at the forward end of said tube, extending to the main deck, with a watertight flat worked on the main deck beams over said tube.

4. All bulkheads are to have stiffeners equal to the main frames; worked vertically on one side not over 27 inches apart, and horizontally on the other not over 48 inches apart, or from floors or from deck beams. The edges of the bulkhead plates may be flanged in lieu of using stiffening angles.

5. The forward collision bulkhead plating is to be 5 pounds heavier throughout than required for the lower half of other watertight bulkheads. In all passenger and freight vessels of 500 tons and above, and in all vessels of 15-foot molded depth or 30-foot molded breadth, extra stiffening, consisting of bulb or web plates, is to be secured to the center vertical stiffener of said bulkhead.

6. (*a*) Coal-bunker bulkhead plating is to equal that of the upper half of the regular watertight bulkheads, but it need not exceed 8 pounds. The athwartship bulkheads are to have vertical stiffeners equal to the reverse bars, spaced not over 27 inches apart. Wing bulkheads are to have stiffeners equal to the main frames spaced not over 1 1-2 frame spaces apart, or they may be of reverse bar size if spaced at every frame.

(*b*) When a wing bulkhead, measured on the line of the bulkhead from the shell or inner bottom plating to the top of the deck beams, is or exceeds 9 feet in depth, tie bars worked at half-depth are to connect every third frame to the bulkhead stiffener in way of said frame.

### 19. Shaft Tunnels.

1. Merchant vessels with machinery placed amidships, and steam yachts of 500 tons and over, should be fitted with a shaft tunnel. When the tonnage is under 500 the plating need not exceed 8 pounds, but when the tonnage is 500 and above, the plating should be at least of 10 pounds. Stiffening bars, equal to main frames, should be spaced not more than 4 feet apart, and they should extend inside all around the sides and top of the tunnel. The part of said tunnel which comes under a hatch should have a wooden covering equal to main deck planking; with angle bars all around the edges of said cover so as to prevent chafing.

2. A watertight door is to be fitted at the engine room end of the tunnel; said door to work from the upper deck. A watertight stiffening box should be fitted to the shaft where it passes through the bulkhead at the engine room end of the tunnel.

### 20. Centerboard Trunks.

1. The centerboard trunk, or an attached trunk containing the manipulating gear, should extend to the main deck.

2. The lower plating should be of the same weight as the midship floor plates; being secured to a flat plate keel with continuous angle bars equal to the main frames or by a double riveted flange. The floors are to have a double clip connection to said plating; the clips being joggled over the keel bars when a flat plate keel is adopted. The upper plating is to equal that of the lower part of the regular watertight bulkheads, with its lap to the lower plating above the top of floors. Stiffeners, equal to reverse bars, are to be worked at every frame, extending from the top of floors to the main deck beams.

3. There is to be a stringer plate, in width 2-3 the center depth of floors, but equal to them in weight, on top of floors on each side of the centerboard case, secured to the trunk plates with an angle bar equal to the main frames. Said stringer plates are to extend at least one frame space beyond each end of the centerboard case and be joined to the middle line keelson.

4. The trunk plating is to be secured to a tie plate on top of the main deck beams with angle bars equal to the reverse bars. The plating is to be scored out so that said deck beams can be worked continuously, with watertight staple work at same.

(*Note.*—When a centerboard trunk is worked flush with the top of floors, as in deep-draft yachts, the reverse

bars should be secured to the fore-and-aft angle bar on each side of the top of said trunk, or else reverse clips should be worked across the top of said trunk connecting the ends of the interrupted reverse bars: or other means be provided for maintaining the continuity of strength.)

### 21. Shell Plating.

1. The shell plating should maintain its midship scantling for 1-2 length amidships. All shell plates should be at least six frame spaces in length except at the extreme ends of a ship. Butts of adjoining strakes are to have at least a two frame-space shift; those of alternate strakes a one frame-space shift. Butts of the garboard strakes, when a bar keel is adopted, are to have a two frame-space shift from each other, and are to be kept well clear of the keel scarphs. When a flat plate keel is adopted, the garboard butts can be in the same frame space, but they must be at least two frame spaces from the keel-plate butts. Sheer and gunwale strakes are to have a two frame-space shift from the butts of their respective deck stringers.

TABLE 7.—REDUCTIONS IN WEIGHT OF SHELL PLATING. LBS.

| Part of Shell Plating. | Shell Plating Including Sheer Strake. | | | | | Garboards. | |
|---|---|---|---|---|---|---|---|
| Type of Vessel. | Steamers. | | | Sailing. | | Side Wheelers. Twin Screw. | Single Screw. |
| Tabulated Weight Amidships. Lbs. | 10 under 16 | 16 under 22½ | 22½ and above. | 12 under 17 | 17 and above. | 14 and above. | 16 and above. |
| For ¼ length fore and aft the ¼ length amidships | 2 | .. | Gradually reduced fore and aft of ¼ length amidships to 6 lbs. less at extreme ends. | 2 | .. | 2 | [a] 2 |
| " ⅛ " " " " " " " " | .. | 2 | | .. | 1½ | .. | .. |
| " ⅛ " at ends | .. | 4 | | .. | 3 | .. | .. |

Reductions to be figured from weight of midship plating.
a. Forward of the ¼ length amidships only. Aft plating to maintain full midship weight to stern post.
No reduction will be allowed abaft the ¼ length amidships in vessels with machinery located aft.

2. Sailing Vessels.

(*a*) When the tonnage is 200 but under 800, one bilge strake is to be 2 pounds heavier than the tabulated weight. When the tonnage is 800 and above, two bilge strakes are to be 4 pounds heavier than the tabulated weight.

(*b*) When under 50 tons, sailing yachts should have one strake at bilge 2 pounds heavier than otherwise. When of 50 tons and above, to have the main sheer strake and one bilge strake 2 pounds heavier than otherwise.

3. Single-screw vessels are to have those plates which are attached to the stern post of the same weight as the midship plates of the corresponding strakes.

4. The bulwark plating is to be of at least 6 pounds in vessels of less than 500 tons and fitted with close bulwarks; said plating to be not less than 8 pounds when the tonnage is 500 and above.

5. The side plating of full poops; topgallant forecastles; midship bridge houses; and of hurricane-deck vessels above the main deck, can be reduced by 2 pounds fore-and-aft of the 1-2 length amidships, when the midship weight is 8 pounds or above. The sheer strake of said decks is to be of the same weight as the side plating, but it is to maintain its full midship weight throughout.

6. The sheer strake of a raised quarter or fore deck located within the 1-2 length amidships is to be of the same weight as the side plating of a full poop, etc., vessel as above (No. 5), but with a reduction at ends as specified in Table 7 as for general shell plating.

7. Tug-boats are to have their main sheer strake and one bilge strake 2 pounds heavier than otherwise when under 100 tons. When of 100 tons and above, the main sheer strake is to be 3 pounds heavier, and one bilge strake 2 pounds heavier than otherwise.

8. In vessels trading upon the Great Lakes that part of the vessel's shell plating, except the flat keel plates, which would ground in shoal water, is to be 25 percent heavier than otherwise; but in no case need it exceed 30 pounds.

9. Shell liners at bulkheads are to extend from the fore edge of the frame before to the aft edge of the frame abaft the bulkhead.

10. When cargo ports are cut in the shell plating under the main sheer strake, and are two or more frame spaces in length, the shell strake above and below said door opening is to be doubled for at least two frame spaces fore-and-aft of said opening. Unless absolutely necessary the main deck sheer strake should not be cut for a port door; but when it is cut, it must be reinforced so as to maintain the continuity of strength.

11. In a vessel with a raised quarter or fore deck and not over 500 tons, the main sheer strake at the point of the break is to be 2 pounds heavier than otherwise, with treble-riveted butts, for not less than 5 frame spaces fore-and-aft of said point, if the length of either of said decks exceeds 1-4 the vessel's length for tonnage. When the tonnage is over 500 and said length exceeds 1-4 the vessel's length the main sheer strake is to be worked double for the same distance.

### 22. Butt Straps.

1. The fiber of all double- and treble-riveted butt straps must run in the same direction as that of the plates they connect.

2. All butt straps must entirely cover the seams of the plating over which they are fitted.

3. Double butt straps are to be fitted to all continuous plate keels and keelsons; to all continuous plate middle-line keelsons; to all middle-line keelsons on top of floors; to all side longitudinal plate girders of double-bottom vessels; and to all floor plates.

4. The thicker of two plates is to regulate the thickness of the butt strap that connects them.

5. Double butt straps must not be less than 3-4 of the thickness of the plates they connect.

6. Single-riveted butt straps must at least equal the thickness of the plates they connect and be in width at least 7 times the diameter of the rivets used.

7. (*a*) Double-riveted butt straps must not be less in thickness than the plates they connect.

(*b*) In vessels of 500 but under 1,000 tons, all double-riveted butt straps of the shell plating below the main deck are to be 2 1-2 pounds heavier than the plates they connect for 1-2 length amidships. But when the tonnage is 1,000 and above, they are to be 2 1-2 pounds heavier all fore-and-aft.

8. Treble-riveted butt straps must be at least 2 1-2 pounds heavier than the plates they connect. When fitted to shell plates 54 inches or more in width, they must be 4 pounds heavier than stated in Table 8.

9. Single butt straps fitted to a steel deck are to be 2 1-2 pounds heavier than the plates they connect. In bulk freight vessels upon the Great Lakes with machinery fitted aft, said straps are to be 5 pounds heavier than the plates they connect if worked single; but not less than 3-5 of the thickness of the plates they connect if worked double.

10. (*a*) Butt straps of the inner-bottom plating are to be 2 pounds heavier than said plating when worked single.

(*b*) In bulk freight vessels upon the Great Lakes with machinery fitted aft, the butt straps of the inner-bottom plating are to be 4 pounds heavier than plates they secure when worked single; but not less than 3-4 the thickness of said inner-bottom plating when worked double.

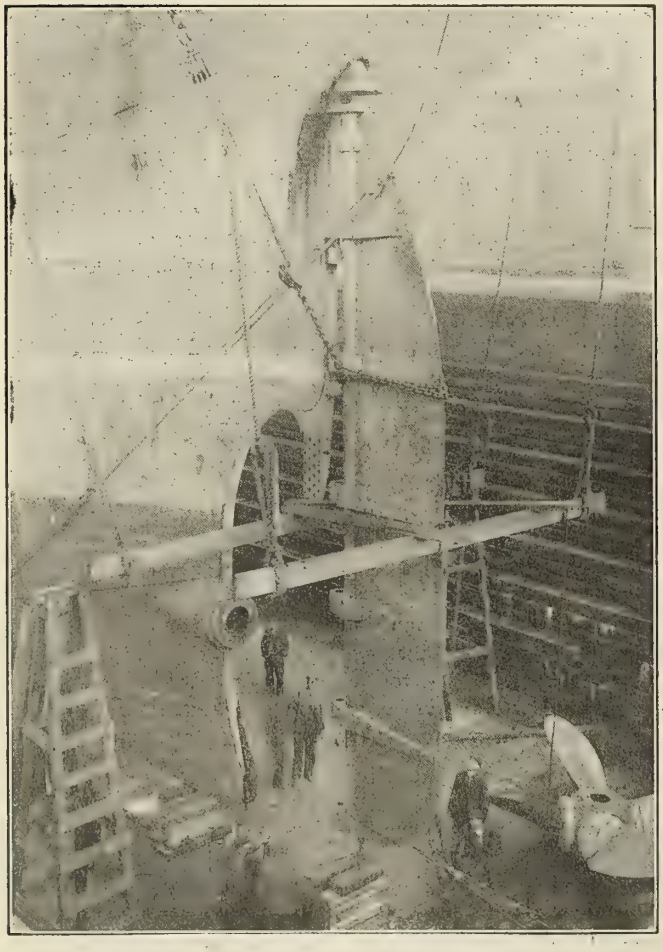
11. All angle-bosom clips at the reverse-bar butts are to be of same scantling as the reverse bars.

12. Width of single-riveted edge strips are to be not under 7 or over 8 diameters of the rivets used. Width when double-riveted is to be not less than 11 1-2 or more than 12 1-2 diameters of the rivets used.

13. Edge strips are not to be of less weight than the plates they connect.

TABLE 8.—WEIGHT OF DOUBLE AND TREBLE RIVETED BUTT STRAPS.

| Weight of Plate. Lbs. | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 34 | 36 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Weight of double riveted butt straps. Lbs. | 5 | 7 | 9 | 11½ | 13½ | 15½ | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 33 | 37 | 39 |
| " " treble " " " " | 6 | 8 | 10 | 13 | 15 | 18 | 20 | 22 | 24 | 26 | 29 | 31 | 33 | 36 | 40 | 42 |



REPLACING THE STERN POST OF THE OAKWOOD.

### Repairs to the Steamship Oakwood.

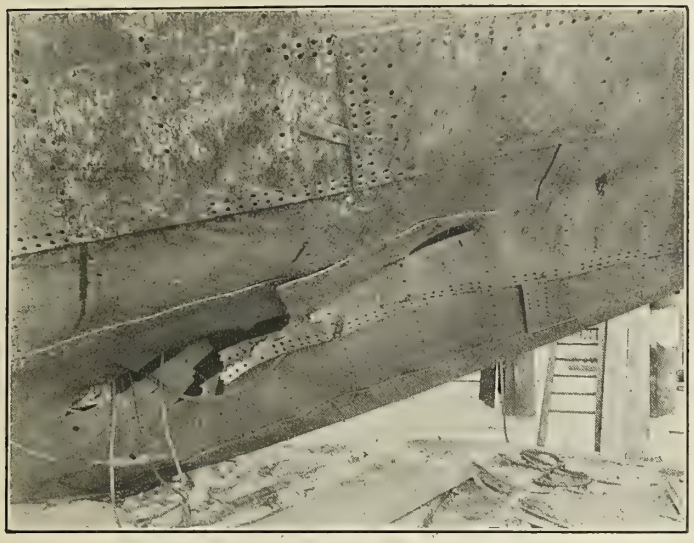
Having run aground in Delagoa Bay the steamship *Oakwood* was repaired in New York by the fitting of a forged iron stern frame. She later again grounded on a voyage from London to Buenos Ayres, off Point Indio, near the river Plate, and having discharged cargo at her destination she returned to Hull, England, where she was placed in dry-dock and thoroughly overhauled, the forged iron stern post being replaced by a steel one. The extent of the repairs is shown in the accompanying photograph.

The *Oakwood* measures 2,792 tons net, and 4,271 gross, has a length of 360 feet, a beam of 48 and depth of 28 feet. The triple-expansion engine has cylinders 25, 41, and 69 inches in diameter, with a 48-inch stroke. She was built in 1903.

### The Damage to the City of Everett.

In collision with the Norwegian steamship *Leif Erickson*, off the coast of Florida, the steamer *City of Everett*, belonging to the Atlantic Refining Company, of New York, sustained damages to the bottom which are shown in the accompanying photograph. Strange to relate the bow of the ship did not appear to have been damaged, all of the trouble appearing to have come far back from the fore foot and under the bottom, where the plating was broken and bent, as shown. The *City of Everett* is of the whaleback type, and was launched in 1895 by the Pacific Steel Barge Company of Everett, Wash. It is said that she is the largest steel merchant vessel ever constructed on the Pacific coast. She measures 348 feet length between perpendiculars, 351 feet over all, 42 feet beam, 25 feet 6 inches deep, and carries 4,200 tons of cargo and 375 tons of coal. Her tonnage is 2,504 gross and 1,858 net. She is divided by six watertight bulkheads, and is propelled by a triple-expansion engine with cylinders 24, 38, and 64 inches in diameter, with a 42-inch stroke. She has four Scotch boilers measuring 11 feet in diameter and 11 feet long, and designed for a working pressure of 165 pounds. Repairs were made at the Erie Basin.

The *Leif Erickson* was built at Bergen, Norway, in 1889, measured 288 feet in length, 38 feet wide, and 20 feet in depth,



THE DAMAGE TO THE BOTTOM OF THE EVERETT.

(Photo by Geo. P. Hall & Son.)

with a gross tonnage of 2,128 and net 1,340. She was propelled by a triple-expansion engine with cylinders 21, 35, and 58 inches in diameter by 36-inch stroke.

## ENGINEERING SPECIALTIES.

### A New Surface Condenser.

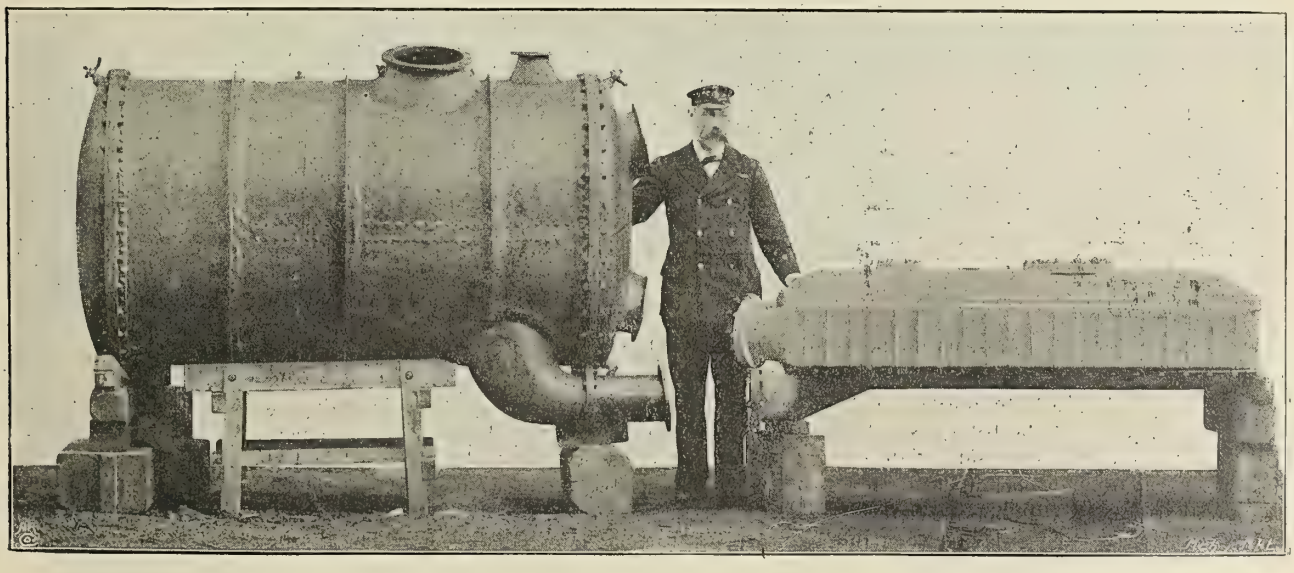
The Ljungstorm patent surface condenser, which is illustrated in the accompanying photograph, differs from the ordinary condensers of this type in that the cooling surface consists in a series of corrugated plates of sheet brass fixed together in packets so arranged that the corrugations give mutual support to each other. These plates are placed in a rectangular casing in such a manner that the cooling water flows horizontally through alternate chambers, and the steam to be condensed flows vertically through the intermediate chambers. By this means a large number of fine streams of steam and water are made to follow a sinuous course in close proximity to each other. The steam enters at the top of the rectangular casing, and is sucked out at the bottom by the air pump. The illustration gives an idea of the relative sizes of this new condenser and a condenser of the ordinary type, both designed for the same work on a torpedo-boat destroyer.

This condenser is placed upon the market by John Brown & Company, the American representative being Mr. W. Bloor, 22 Thames street, New York.

### The Babcock Fire Extinguisher.

This is the invention of Professor James Babcock, of Boston, and dates from about 1870. It is only recently, however, that it has been arranged for use on shipboard. The principle on which it operates is the mingling of bicarbonate of soda with sulphuric acid to generate a sufficient pressure to throw a stream of the

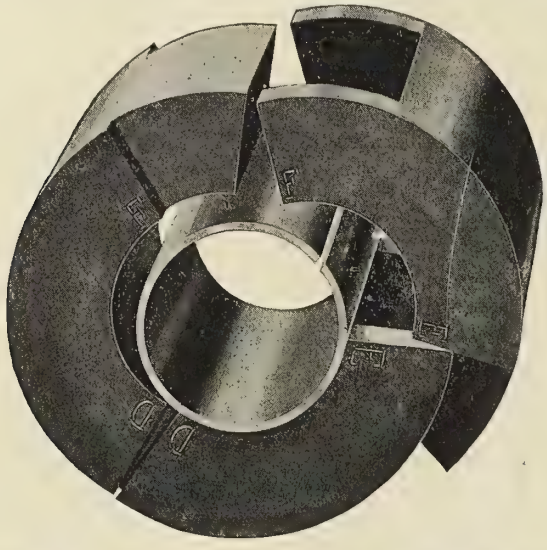
chemical for fire-extinguishing purposes, and it is the carbonic gas generated which operates as an extinguisher. The Babcock, as constructed by the American-La France Fire Engine Company, of Elmira, N. Y., is made of one solid sheet of heavy copper, without rivets or joints, and leaded on the inside to prevent corrosion.



In operation the acid bottle is broken and the entire contents thrown into the soda at once, as compared with which other extinguishers allow the acid to be thrown gradually into the soda, and thus do not attain their highest efficiency at the start, when it is most needed. The stream is controlled by a shut-off valve which prevents waste.

### The Stayman Piston Valve.

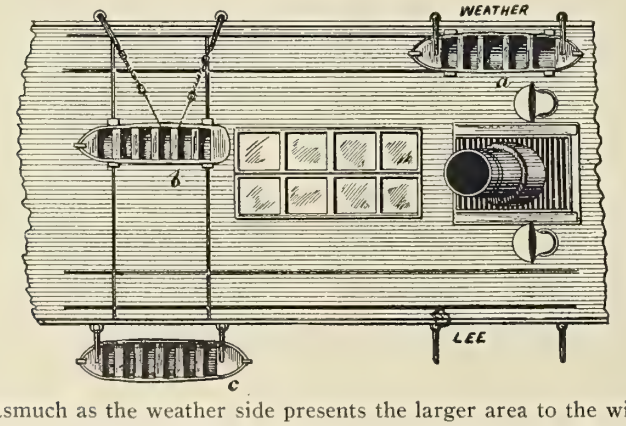
The main feature of this valve, which differentiates it from those of the regular type, consists in the method of holding the piston against the casing. Instead of having a solid head with small piston rings pressed out by either their own elasticity or that of springs, this valve has a head which consists of three parts so



arranged as to prevent the leakage of steam past them, and held to their work by means of a central spring, as shown in the photograph. Tests of these valves appear to show a considerable increase in efficiency over the older type, while the design is especially well adapted to avoid unequal conditions of wear. The valve is marketed by the Stayman Manufacturing Company, 143 Liberty street, New York.

### A New Boat-Launching Gear.

In cases where a ship of modern construction becomes disabled it is obvious that all the boats should be at once available. A ship in such a predicament usually lists over dangerously, and




inasmuch as the weather side presents the larger area to the wind and to the sea, she naturally swings so as to present this side flat to the weather. Under such circumstances the ship becomes, as it were, a breakwater, and the list causes the lee davit tackle to swing outwards, away from the side of the ship. To launch the weather boats from their proper davits would be to ensure their destruction; if they can easily be moved to leeward, so that they may be lowered from the lee davits when the tackle is clear of the lee boats, a great increase has been attained in the life-saving power of the ship's appliances.

The chocks are of the ordinary type now used, but instead of resting flat upon the boat deck they are supported by ball rollers, which run in a slightly grooved rail let into the deck. Normally wedges hold the boats firmly in position against motion of the ship. The grooved rails run transversely and also longitudinally, and cross-junctions are provided. By the figure we may describe the procedure: The boat *c* is ready for launching on the lee side; *b* is being run over the thwartship grooved track ready to occupy the davits and tackle now holding *c*, and the weather tackles are attached to *b* to "brake" its run down the decline of a possible "listing" deck. The boat *a* may be run along the fore-and-aft track clear of the funnel, ventilators, and skylight, and then thwartships to the nearest lee davits that happen to be free. The device is a recent invention of Captain V. H. Spalding, of London.

## TECHNICAL PUBLICATIONS.

**The Mechanical Handling of Material.** By George F. Zimmer, A. M. Inst. C. E. 521 pp. 7½ by 10¼. 542 illustrations. New York: D. Van Nostrand & Company, 1905. Price $10 net.

This very important book had its original basis in the author's practice in the general line of handling material, and in the designing of appliances for its mechanical handling and transportation. It has not, however, been by any means confined to the practice of any one man, or any one country, but deals with work comprised within the general heading all over the world, and gives examples from the practice of perhaps hundreds of engineers of the last two or three decades. Being very copiously illustrated, it is of especial value to engineers interested in the subject, and ought to form an excellent reference book. The work is divided into four sections, of which the first is devoted to the continuous handling of material, and gives details of various sorts of elevators, worm and band conveyors, and conveyors designed for special purposes, such as those used in connection with casting machines. The second section deals with the intermittent handling of material by means of ropeways and aerial cableways, including appliances for coaling at sea. The third section is devoted to handling and loading appliances, such as skips, grabs, and various means of utilizing the machinery usually found in connection with elevators. This section also describes the discharging of railway trucks, both by the method of picking up the truck and overturning it, and by the method of dumping the contents of a truck specially designed for that purpose upon either one or both sides of the track, or in the middle. The fourth section is devoted to miscellaneous devices for the handling of material, and includes information about its automatic weighing, the coaling of railway engines, and the general subject of coal stores and coal silos.

Some little attention is paid to the very remarkable systems employed upon the Great Lakes of the United States for the loading and discharging of cargoes on the specially designed vessels used in these great inland fresh-water seas, and at the same time information is given regarding the contemporaneous practice of European engineers both in England and on the Continent. The book is gotten up in splendid style and ought to be very valuable to all engineers concerned with any phase of the subject.

**The Shipping World Year Book.** Edited by Evan Rowland Jones. 1,316 pp. 4½ by 7¼ inches. New York: The Derry-Collard Company, 1905. Price $3.

After an introduction involving a retrospective view of the year 1904, this book goes on with a mass of tables of interest to shipbuilders and shipping men generally, such as a list of ports in the world, with ships entered and cleared; statistics of imports and exports; astronomical and tidal information; tables of freeboard; particulars of Suez Canal traffic; general statistics of ships of various nations, etc. There follows a digest of the shipping acts

of the various countries, and after this come two very important sections, which occupy more than a thousand pages in the book. The first of these is a port directory of the world, giving all ports used by steamers and sailing vessels, with very complete particulars regarding the population, the size, and depth of the harbor, the condition of the channel, and all sorts of information of a like character. The other section deals with the tariff laws of the various countries, giving schedules in sufficient detail to be of immense value to shipping men generally. In a pocket in the rear of the book is a map of the world, on Mercator's projection, printed in four colors, and giving marginal maps of a number of the most important ports, such as New York, Liverpool, Cork and Queenstown, Southampton and Portsmouth, San Francisco, Rio Janeiro, London, Yokohama, and a number of others. We have no doubt that the work will find a ready acceptance at the hands of those engaged in forwarding merchandise or operating ships.

**Gas Engines and Launches: Their Principles, Types, and Management.** By Francis K. Grain, M.E. 123 pp. 4½ by 6¾ inches. 21 illustrations. New York: Forest and Stream Publishing Company, 1905. Price $1.25.

This little book, which ought to be of special interest and value to owners and operators of gasoline launches, covers quite thoroughly the general subject of the gasoline engine of both the two-cycle and the four-cycle type, and gives a large amount of information on what might be called the subsidiary devices of the engine, such as igniters, vaporizers, etc., as well as wiring schedules for batteries. The subject of propellers and hulls is given merely incidental notice at the rear of the book, where some general remarks are made regarding the proportioning and design of both of these features of the boat. The last part of the book is devoted to discussions of the methods of management of the engine and boat, and a series of cautions as to what to do or not to do under various contingencies.

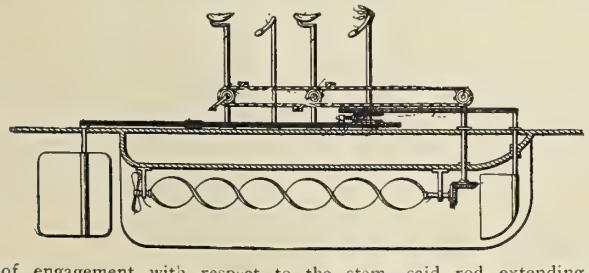
**The Nautical Technical Dictionary for the Navy,** in English, French, German, and Italian. Vol. II., Part 1, A to K. 1,355 pp. Pola: published by Mitteilungen aus dem Gebiete des Seewesens, 1905. Price 30 marks.

This monumental work is the result of many years of labor on the part of Julius Heinz, a retired rear-admiral of the German navy, the first volume having appeared in 1900, and the second at this time. The dictionary is arranged in two ways, the first being with all English and French words in sequence, and the second being systematical according to the similarity of technical meaning and application. The object of the latter arrangement is to facilitate research and the finding of special words. For the purpose for which it was designed, the work will prove exceedingly valuable, and should find ready acceptance by all who might have occasion to refer to anything of the sort.

## SELECTED MARINE PATENTS.

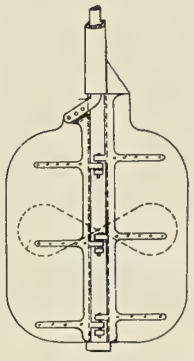
793,633. BOAT. JOHN W. BEALL, LATON, CAL.

*Claim.*—3. A boat having fore and aft rudders, a steering post or stem, wheels on the said stem arranged one above the other, the stem and one of the wheels having separable connecting means for throwing one of the wheels out of operative engagement with relation to the post or stem, a rod connected to the wheel which is adapted to be thrown



out of engagement with respect to the stem, said rod extending adjacent to the upper terminal of the said stem, and flexible connections between each wheel and one of the rudders whereby the latter may be simultaneously or independently operated in either direction. Three claims.

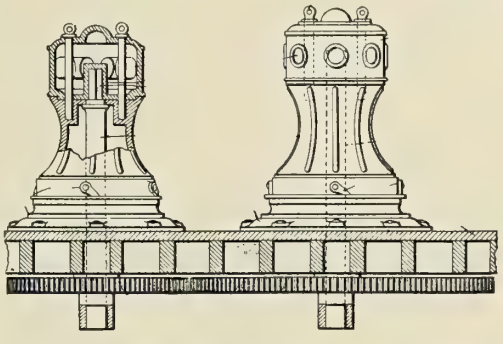
793,746. MEANS FOR CONTROLLING THE SPEED OF SCREW-PROPELLED SHIPS. EDWARD SMETHURST, CHRISTCHURCH, NEW ZEALAND.



*Claim.*—1. In means for controlling the speed of screw-propelled ships, a sleeve upon which is mounted a rudder and a shaft coaxially situated with and within the sleeve upon which a second rudder is mounted, and means for operating the pair of rudders either together or reversely to each other in conjunction wth the revolving propeller of a ship. Three claims.

793,909. CAPSTAN. WILLIAM J. ROBERTS AND ALBERT F. SHULTZ, KEYWEST, FLA.

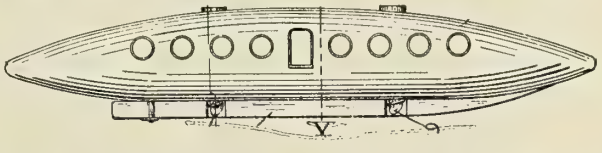
*Claim.*—3. In a capstan construction, spaced shafts connected for rotation by gears of different diameters, a capstan mounted for rotation



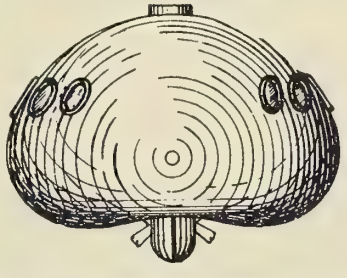
upon each of said shafts, each of said capstans having a head connected for rotation with its respective shaft, and removable pins extending through said head members into their respective capstans and forming detachable coupling means between them. Three claims.

793,944. BOAT. CAREY A. MANKER, PEARL, ILL.

*Claim.*—1. A boat having a concavity at the lower side of its hull terminating at its forward end above the lowermost surface of the hull to provide free entrance for water into the front end of the cavity; said concavity merging into the lowermost surface of the hull at its rear end rearward from the longitudinal center of the boat.



2. A boat having at the lower side of its hull a pair of longitudinal limbs extending from the forward end of the hull to a point beyond the longitudinal center of the hull; said limbs providing a concavity terminating at the forward end between said limbs and above



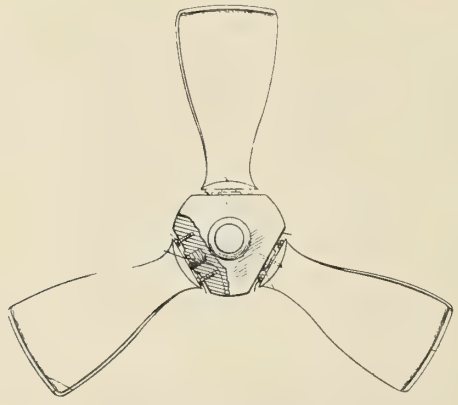
the lowermost surface of the hull and terminating at its rear end at the lowermost surface of the hull and rearward from the longitudinal center of the boat. Two claims.

794,010. PROPELLER. WILLIAM B. HAYDEN, NEW YORK, N. Y.

*Abstract.*—This invention relates to screw-propellers; and the object thereof is to so construct the propeller as to enable the adjusting of the propeller-blades to a less or greater degree of pitch, whereby the position of the blades may be adapted to the particular degree of speed or power desired in the vessel propelled.

The invention further aims to provide a screw-propeller with a plurality of adjustable abutments adapted to engage the base of the blades to prevent the turning or loosening of the blades when in their set positions.

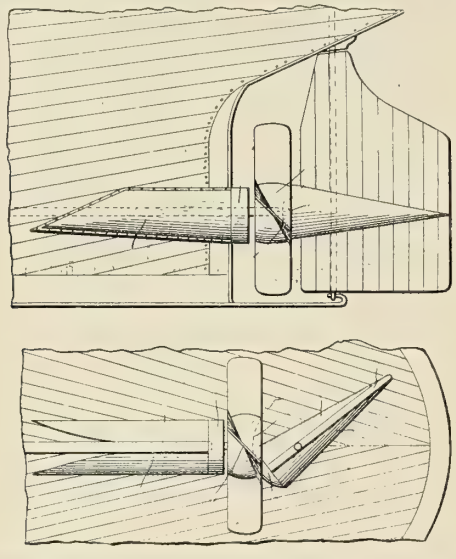
The invention further aims to provide a screw-propeller with means



to readily ascertain whether the proper degree of pitch has been obtained when positioning the blades. Twelve claims.

794,317. PROPELLER FOR VESSELS. JOHN SAUNDERS, JR., GREENBAY, WIS.

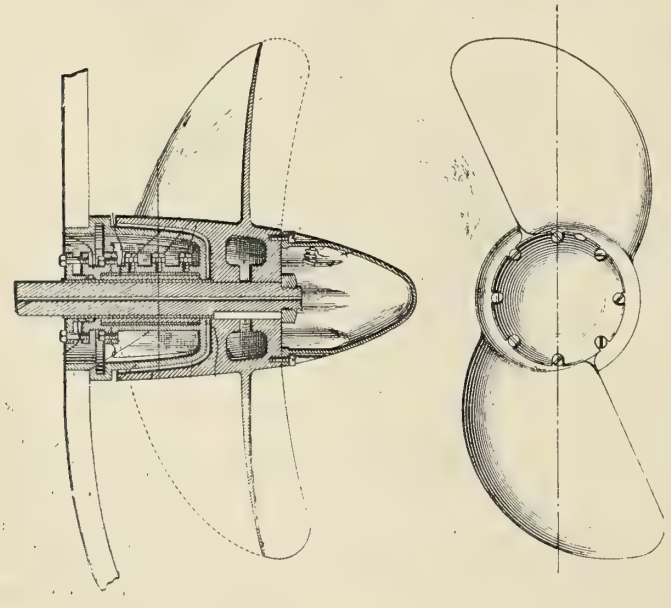
*Claim.*—A vessel having a propeller having an enlarged hub, said vessel having a water-shed disposed in front of the propeller-hub and corresponding in diameter at its rear end to the diameter of the hub, the latter



having a concave recess in its rear side, and a rudder having a cap provided with a crown of segmental form projecting from the front side of the rudder and extending into the recess in the propeller-hub. One claim.

794,932. PROPELLER. JOHN D. FULLERTON, BOSTON, MASS.

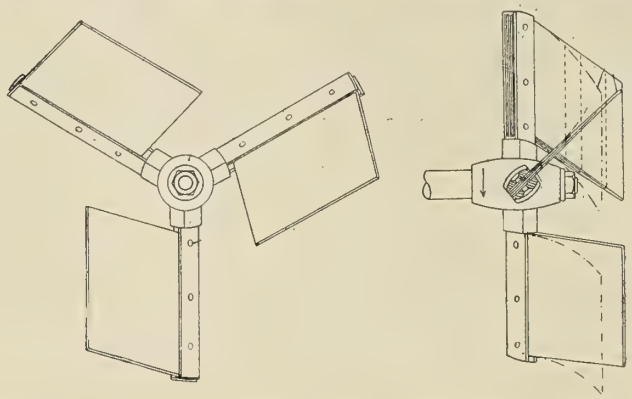
*Claim.*—1. In a propeller, a propeller-shaft, a bearing therefor, a screw-propeller on the bearing, said propeller having a hub formed with an extension which overlies and surrounds the bearing, and also having thin blades extending forwardly to the front edge of the hub extension, and



having an entrance edge which slants backwardly in the direction of the length of the shaft. Four claims.

794,984. PROPELLER. JOSE HUBER, SANTIAGO, CHILE.

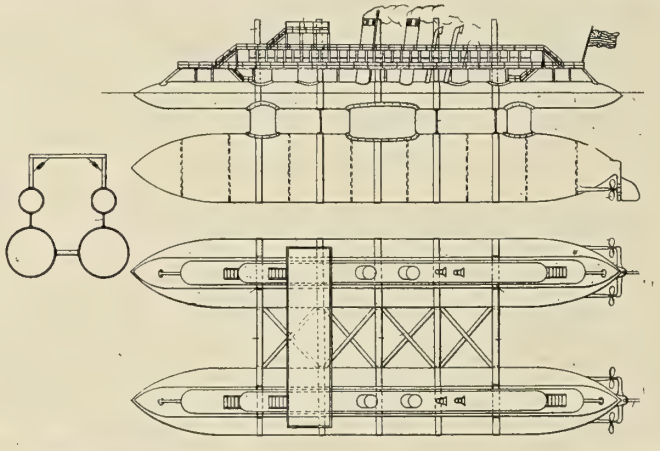
*Claim.*—9. In a propeller, the combination, with a shaft, and rigid supporting-arms carried thereby, of resilient laminated blades secured to the arms at substantially right angles to the shaft, said blades being



composed of a plurality of plates of unequal length arranged between two outer plates of substantially equal dimensions and having the shape of a rhomboid, substantially each portion of the operative surface of the blades lying within a circle struck from the axis of the shaft and having a radius equal to the length of the arms. Sixteen claims.

795,002. VESSEL. ALBIN NELSON, GLADSTONE, MINN.

*Claim.*—2. A vessel of the class described consisting of two submerged hulls, propelling mechanism therefor, a pair of smaller hulls supported

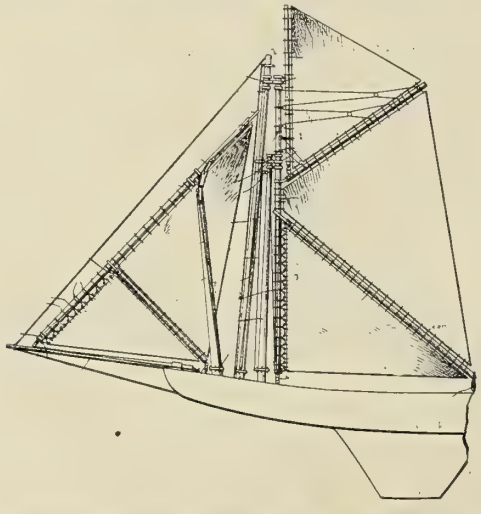


above said submerged hulls, and a bridge connecting said upper hulls. Four claims.

795,025. RIG OF SAILING VESSELS. BYRON W. COLLINS, EVANSTON, ILL.

*Claim.*—5. In a fore-and-aft-rig sailing vessel a two-part sail, a boom extending between the two parts of the sail and secured thereto, the jaw of the boom being arranged higher than the peak and the latter being secured to the clews of both parts of the sail.

6. In a rigging of the class described, a mast, a pivoted lever, a sail-carrying arm, a sail carried by the arm and extending upward above



the point of connection between the arm and lever, and a pair of halyards arranged one on each side of the lever and extended upward following the lines of the lever and arm and connected to the peak of the sail. Nine claims.